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POSTOPERATIVE TREATMENT

AN EPITOME OF THE GENERAL MANAGEMENT OF POST-OPERATIVE CARE AND TREATMENT OF SURGICAL CASES AS PRACTISED BY PROMINENT AMERICAN AND EUROPEAN SURGEONS. TOGETHER WITH SUGGESTIONS CONCERNING THE TECHNIQUE OF CERTAIN OPERATIONS WITH A VIEW TO SECURING BETTER POSTOPERATIVE RESULTS

BY

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TO

ELBERT WARREN CLARK, M.D.

ONE OF THE GRAND SURGEONS OF IOWA

AS A TOKEN OF FRIENDSHIP AND LONG ASSOCIATION

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PREFACE.

The average graduate in surgery knows but little concerning the proper management of postoperative treatment of surgical cases; most of his time in college being engrossed with what appears to be the more important matter of surgical technique, pathology and bacteriology. He realizes the great importance of minor details only when, in actual practice, he is thrown upon his own resources, and the skill he may then acquire is obtained through personal experiences with suffering patients. He may visit the greatest clinics and witness the most brilliant operative technique, but the curtain falls and his observation ceases on the removal of the patient from the operating amphitheatre.

I have long regarded postoperative care and treatment as being equal, if not of greater importance, than mere brilliant technique. Faulty technique may complicate or retard recovery, but faulty postoperative management has robbed many surgeons of what should have been successful results.

The practice of asepsis and antisepsis has removed many complications which heretofore so commonly followed surgical operations. But from my own experience and the observation of cases occurring in the practice of some of our best surgeons I am forced to conclude that infection is often unavoidable and frequently occurs under the most favorable circumstances. It is these cases that frequently tax to the utmost the skill and ingenuity of the postoperative attendant.

Surgeons differ radically over the management of similar cases, each basing his opinion on conclusions evolved from personal experience, hence the meagre information given this important subject by the average modern text-book is frequently conflicting and therefore a disappointment to the student and busy surgeon.

I have long felt the need of a work of this character, and have attempted to compile a rational system, a text-book or guide to the proper postoperative management or treatment, which, so far as I have been able to ascertain, is the first work devoted exclusively to this subject brought before the profession.

The character of the work admits of little originality. What follows is, therefore, an epitome of the various methods used or adopted by modern American and European surgeons, much of the information being derived from personal letters, text-books, medical journals, etc., supplemented when possible by what my own experience has led me to believe is rational and practical.

I have intentionally omitted all reference to surgical pathology and bacteriology, confining myself as strictly as possible to the subject under consideration.

NATHAN CLARK MORSE.

ELDORA, IOWA, *October* 1, 1905.

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CHAPTER I.

PREPARATION OF THE PATIENT.

GENERAL REMARKS.

The proper preparation of patients for surgical operation is of such importance and has such bearing upon the postoperative treatment, that we shall be pardoned for devoting the time and space necessary for a brief review of the subject. The rationale of preparatory treatment is based upon the principle that the entire system should be as nearly normal as is possible. Robert T. Morris says: "All the avenues of elimination must be open and active, in order to overcome conditions that lead to autointoxication, and render infection the more probable."

If digestion is faulty, the diet should be restricted, and the condition relieved. If the liver is torpid and constipation present, laxatives are indicated, or brisk purgation necessary, in order that the intestinal tract may be rid of toxic matter. Should the kidneys be at fault, the judicious use of diuretics may prove of value. A general bath every third or fourth day, or oftener, with friction or massage, increases the action of the skin and relieves the kidneys. The plan of general preparation of patient herein advocated is that which is uniformly used at the Eldora Emergency Hospital, and applies to all except emergency cases in which immediate operation is imperative.

The patient upon entering the hospital is given a warm bath, ordinary castile soap with a good flesh-brush being sufficient. If the patient is a female, a hot douche of one ounce of sodium bicarbonate to one gallon of water is given, followed by a douche containing $\frac{1}{2}$ ounce of creolin to one gallon of water, or a one percent solution of lysol; after which the patient is dressed in a clean gown and sent to a room or ward. A complete history of the case is obtained, and a careful physical examination is made to determine the nature or extent of the operation required and the general condition of the patient. Should this examination reveal the existence of phthisis, Bright's disease, jaundice, diabetes, or any other condition that would render the operation unusually haz-

ardous, the preparatory treatment must be directed specially to that condition.

A chemic (and later, if necessary, a microscopic) examination of the urine is made, and the quantity of urine passed in twenty-four hours is carefully noted. If immediate operation is not necessary, and the general health of the patient is impaired, she is at once placed in bed, and tonics and restoratives are administered. If the appetite is lost, a good preparation of cod-liver oil, with tincture of nux vomica, colombo, or gentian, is helpful. If the urine is scanty or deficient in quantity, copious and frequent drafts of water, plain or carbonated, are insisted upon, and are of special value if the patient is a nervous woman. Constipation is overcome by the daily administration of compound licorice powder, preparations of cascara sagrada, or compound aloin pills. If anemia is marked, fresh gelatin-coated Blaud's pills or capsules, with or without arsenic, have proved in our hands of greater value than many of the modern preparations of iron. If there is marked debility with anemia, not dependent upon hemorrhage or septic conditions, in addition to the above, inunctions of leaf lard (Boody) applied to the back, chest, and inside of the thighs, followed by massage, with daily rectal enemas of normal salt solution, will prove beneficial. If, however, the anemia and exhaustion are the result of hemorrhage, exhaustive discharges, or septic absorption, immediate operation is indicated, after which the system will be in better condition and respond more readily to tonics and restoratives during convalescence.

Five or six days prior to all abdominal operations the entire intestinal tract should be gently but thoroughly evacuated. A calomel purge, administered in the evening and followed the next morning by a dose of magnesium sulfate or castor oil, is usually sufficient.

Kelly recommends the old-fashioned black draft with carminative; viz.:

Magnesium sulfate,	℥j
Senna,	℥iij
Manna,	℥ij
Pulverized cardamom seed,	℥j
Boiled water,	Oj.

Boil and strain, and give 2 ounces every two hours.

The patient is then placed upon a highly nourishing liquid diet (soups and broths), but no milk is allowed. On the evening of the second day preceding the operation a second laxative should be given, in order that the bowels may be free from accumulations; and during this time, in ad-

dition to tonics and reconstructives, we generally prescribe five-grain doses of beta-naphthol bismuth, preferably in capsules, with or without extract of cascara sagrada, as an intestinal antiseptic and laxative. Patients very much exhausted, or those advanced in years, who are to be operated upon early in the morning, may require nourishment during the night; beef-tea or clear soup, and, in extreme cases, brandy or whisky at intervals of three or four hours, may be given with advantage, up to two hours preceding anesthesia. The evening before the operation, after a light supper, another bath is given, after which the patient is placed in bed, and if nervous, twenty to thirty grains of sodium bromid is given to induce sleep. No food or broths of any kind are allowed during the night, but the next morning, not later than four hours prior to the administration of the anesthetic, a cup of hot coffee, black tea, or beef broth is given; otherwise the stomach is kept empty. No purgatives are administered the evening before the operation, nor do we permit flushing of the rectum or enemas of any kind on the morning of the operation, as they frequently annoy both patient and operator.

METHODS OF PREPARATION OF PATIENT BY VARIOUS SURGEONS.

For Laparotomy.—Franklin H. Martin's method is as follows: The intestines are emptied by mercurials and salines. The first night of preparation six grains of blue mass is given. The next morning at six o'clock seidlitz powders are given every hour until the bowels move, or feel as though they would move with the aid of a small enema. This should insure a thorough action throughout the entire length of the intestinal canal. If, with the above treatment, the movements are such as to insure a thorough evacuation and to start a free flow of bile, as indicated by the yellow, glistening appearance of the stool, no further catharsis is necessary. The lower bowel should be thoroughly evacuated, however, by the employment of large enemas of soap and water, repeated four or five times during this second day of preparation. The last enema should be given late in the afternoon of the second day of preparation, if the operation is to done the following morning, or the next morning if the operation is to be done in the afternoon. The bowels are rendered less septic by large doses of bismuth and salol. During the first and second days of preparation ten grains of salol and twenty grains of bismuth subnitrate should be given every six hours.

The bowels are stimulated by means of carminatives, alcoholic stimu-

lants, and strychnin. The second day of preparation oil of cloves, in capsules, is given. In delicate women strychnin is commenced three days before the operation in $\frac{1}{40}$-grain doses every eight hours, and gradually increased in quantity until $\frac{1}{20}$-grain doses are given. The bowels are rendered less septic by feeding the patient on a milk diet for two days before the operation.

For Laparotomy.—Ochsner's method is as follows:

"As a rule, long-continued preparatory treatment leaves the patient in a much less favorable condition for a surgical procedure than a short and simple preparation, which serves to put the kidneys, the skin, and the alimentary canal in condition favorable to the elimination of the waste products.

"Two or three days preceding the operation, the patient should be placed on a light diet consisting of sterilized food, and allowed an abundance of good water, preferably hot, in order to favor elimination through the kidneys. A nonirritating cathartic should be given, and, if possible, a warm general bath. For several years I have given, as a rule, two ounces of castor oil in the foam of beer or malt extract, the day before the operation, and a large soap-and-water enema on the morning of the operation. In this manner the patient is relieved in a relatively short time of all waste matter and is measurably removed from the likelihood of absorbing the products of decomposition which may be present in the alimentary tract. So large a dose of castor oil does not, as a rule, give rise to great disturbance, pain, or exhaustion. I have also found that the foam of beer or malt extract disguises the oil so thoroughly that patients who are ordinarily nauseated will bear this without annoyance. In the vast majority of patients this amount of preparation suffices to relieve the body of any burden it may possess which might interfere with the process of healing. In other words, the patient approaches the operation in a comparatively clean condition; his strength has not been impaired by confinement, and the nervous system has not suffered by looking forward to the operation for a long time."

For General Surgical Operations.—Dr. Joseph Price, of Philadelphia, says: "There are two considerations to be borne in mind in the preparation of patients for operation. In Europe and America it is the rule to admit the patient to the hospital a few days before the operation is to be performed: (1) In the interval between admission and operation the patient is bathed, scrubbed, douched if the operation will involve in any way the vaginal tract, and is purged with calomel and ro-

chelle salts. (2) The proper preparation for plastic work, in addition to that which is required for general surgical procedures, requires especial brush-scrubbing and irrigating of the mucous passages; and that all scar-tissue should be freed to favor easy approximation of the walls of fistulas.

"In abdominal work purgation conduces to favorable postoperative conditions, prevents bowel distention, reverse peristalsis, persistent nausea and vomiting, and renders unnecessary the premature administration of laxatives; in short, the emptied bowel is at rest, as it should be, for the first twenty-four to thirty-six hours after operation. If the bowel is thoroughly emptied and bathed with bile, fermentation and consequent distention do not occur. To fortify the statement that thorough preparation previous to operation is necessary I may add that In 100 patients brought into the hospital suffering from such conditions as suppurative tubo-ovarian disease, diseases of the uterus rendering hysterectomy necessary, appendicitis, gallbladder disease, etc., and prepared during two days and a night previous to operation, there was no perceptible distention in any case, and no alarming postoperative complications.

"It is an error to administer purgatives and enemas soon after operation, or to resort to other persistent efforts to move the bowel; this should have been accomplished before operation, by the use of calomel and rochelle salts, since these, in my opinion, give the best results. Furthermore, calomel stimulates hepatic activity, and the presence of plenty of bile in the lower bowel prevents fermentation and greatly lessens the tendency to distention.

"The 'let alone' treatment after operation gives the best results, but the free use of fluids before operation stimulates the circulation, flushes out the kidneys, and increases the elimination of toxins. It is interesting to note that surgeons who prepare their patients after the above method, and withhold drink(?) for the first twenty-four hours after section, have the largest records for renal secretion in ounces, viz., an ounce or more each hour. Withholding fluids (?) after operations requiring drainage, favors the early removal of the drains.

"The peritoneum is a huge lymph sac and it rapidly digests healthy and noninfectious exudates. This prevents the accumulation of such leakage or exudate, and hinders the development of more virulent germs. Leakage from perforation is primarily safe, but later germs develop in the form of savages, and it requires drains or gill-nets to capture them."

Treves' Method of Preparation.—Sir Frederick Treves' method is as follows:

Period Before the Operation.—"The most thorough examination possible of the patient should be made before an operation is undertaken. To carry this out, it is well that the individual should be under observation for some time before he appears in the operating room. In the case of those who have been long confined to bed, it is obvious that the sooner they are relieved, the better. On the other hand, in the matter of operations of expediency upon patients who may be termed healthy, it is well that they should pass through a period of rest before the operation is performed. Operations hurriedly undertaken are not unfrequently regretted.

"In hospital practice it is better not to operate upon a man who comes straight to the wards from some active outdoor work, who is robust and has been living heartily, and who has still the vigorous throb of exercise in his blood and in his limbs. The practice is frequent, for the operation has been previously arranged, and the man does not want to lose even a few hours' work. Such a patient is placed in an infinitely better condition by a few days' rest in a hospital ward. He here becomes accustomed to his surroundings; he has time to be rid of the refuse matter in his tissues, which can no longer be cast off by muscular exertion; his hearty appetite is enabled to adapt itself to his present requirements; the excreta can be dealt with; and time is allowed (and it is needed in some hospital patients) to make clean the skin. To all the organs, to the still strongly-beating heart, and to the overworked muscles, there is allowed a period of repose. When the operation day arrives, the patient has become acclimatized, strict confinement to bed and a limited diet do not involve so very sudden a change, he has adjusted himself to his new environment, and the ordeal is met after a period of physiologic rest.

"Many small operations would do better if the patient would consent to the preliminary of a few days' rest. This is conspicuous often in operations upon piles, when the subject persists in absorbing himself with his work up to the time of the operation. Often a business man will overwork himself desperately before his operation, in order that his affairs may not suffer in his absence.

"What is worth doing at all is worth doing well, and not a few operations, the performance of and recovery from which have to be compressed within a few hurried days, would better not be performed at all.

In the case of women with long hair, the various coils and twists should be undone, the whole hair parted behind in the median line and disposed of in two simple lateral plaits. The hair is thus kept out of the way—should the operation concern the head and neck—and after the operation the head can rest comfortably upon the natural scalp, and not upon a complicated mound of wisps of hair, hairpins, and other foreign substances."

DIET.—"The practice of starving a patient before an operation is undoubtedly unwise. The amount of the food should be suited to the condition of an individual who is inert and within doors. It should be nutritious, but small in bulk, and not of a character to leave much débris in the intestines. Entire abstinence from alcohol for a week or more before an operation might prove very judicious in not a few instances. The patient who 'keeps himself up' by spirits before an operation is preparing for himself a sore down-going after the event is over."

THE BOWELS.—"The bowels should be well opened on the eve of the operation; and this is best effected by an aperient overnight and an enema in the morning."

PREPARATION OF FIELD OF OPERATION.

GENERAL REMARKS.

General Preparation of the Field of Operation.—The field of operation requires special attention. The skin, if hairy, should be carefully shaved, or preferably a depilatory should be applied; after this the parts are thoroughly scrubbed with green soap and a sterile flesh-brush. If the integument is oily, calloused, or very dirty, gasoline, sulfuric ether, or turpentine may be required, but ordinarily green soap suffices. The parts are then washed with alcohol until all traces of the soap and other foreign substances have disappeared. This is followed by a 1:2000 solution of corrosive sublimate if the skin is not broken, and, lastly, the parts are flushed with sterile water. The entire part or field of operation is then covered with several layers of sterile gauze, moistened with a 1:4000 mercuric chlorid solution, over which a sterile bandage is applied. This procedure applies to amputations in general, and to all operations on the chest, arms, limbs, hands, or feet. In operations upon the face, the eyebrows, beard, and mustache, if in the line of incision, should be carefully shaved, the scalp being thoroughly cleansed and washed as above directed, after which a moist antiseptic gauze dressing covering

the entire scalp or head is applied and held in place by a bandage, which is not removed until the moment of operation. In operations upon the head, if not extensive, clipping of the hair to facilitate cleansing, and shaving the part immediately involved, will suffice.

The Eye.—The eyebrows should be shaved, and adjacent parts, especially the lids and orifice of the lacrimal ducts, carefully cleansed with a boric acid solution, after which a pad of sterile cotton saturated with a solution of boric acid should be applied and held in position by a bandage.

Mouth, Nose, and Throat.—In these regions antiseptics in solution strong enough to be of value cannot be used. Miller has demonstrated that carbolic acid, boric acid, and potassium chlorate are of little value. The routine followed at the Massachusetts General Hospital is as follows: Several days before the operation the patient's teeth are examined by a dentist and thoroughly cleaned. Cavities are filled and all decayed teeth are removed. The cleaning and sterilizing are continued by rinsing the mouth and brushing the teeth, especially about the roots, several times a day with an antiseptic solution. The pharynx, tonsils, and nose should be sprayed at the same time, and this treatment continued two or three times daily until just before the operation. (Warren, "Surgical Pathology.")

The following formula has been suggested by Miller:

Saccharin,	℥ss
Benzoic acid,	gr. xlv
Tincture of ratanhia,	℥ss
Absolute alcohol,	℥iiss
Oil of peppermint,	gtt. v
Oil of cinnamon,	gtt. iv. M.

Sig.—Dilute with ten parts water, or, better, ten parts of a 4 percent solution of hydrogen dioxid, and hold in the mouth for one minute, or use as a spray.

For Stomach Operation.—W. J. Mayo's method is as follows:

A week or ten days prior to the operation, unless contraindicated by exhaustion or disease, the patient is given once daily, before breakfast, lavage of the stomach with normal salt solution or boric acid solution, for the double purpose of mild disinfection, and teaching the patient to become accustomed to the tube. He is placed upon a nourishing liquid diet, exclusive of milk. Owing to the great emaciation of many of these patients, rectal alimentation as well as hypodermoclysis is often necessary. The night before the operation castor oil is administered, and if the stomach is not empty, it is carefully washed out in the morning, preceding the administration of the anesthetic.

Cervix and Uterus.—The same method of cleansing or preparation as for vaginal operations should be done, and it is our custom in all operations upon the cervix, when the patient is under anesthesia, first to dilate and curet carefully the cavity of the uterus before proceeding with the operation proper.

For Operation on Bladder, Urethra, and Kidneys.—Salol or urotropin should be administered in regular doses of seven and one-half to ten grains, three times a day, for the purpose of disinfecting the urinary tract. The patient should be induced to drink large quantities of water. The morning of the operation the bladder and urethra require thorough cleansing through a double catheter by means of irrigation with boric acid or Thiersch's solution. This is best accomplished when the patient is under anesthesia.

PREPARATION OF THE FIELD BY DIFFERENT SURGEONS.

Howard Kelly's method is as follows ("Operative Gynecology," D. Appleton & Co.):

In order that the field of operation may be rendered as nearly aseptic as possible before the patient is taken to the operating room, the most active disinfecting measures are employed. All of the articles necessary for cleansing the abdomen are placed in convenient reach. Usually a small stand is placed near the bed, and upon this are placed green soap, flasks of water and of mercuric chlorid solution (1:1000), a package of sterile towels, gauze, scrubbing mops, alcohol, and ether. The abdomen is well exposed, the bed and clothing above and at the sides being protected by a rubber sheet. The skin from the ensiform process to just above the pubes is lathered with green soap and water, and shaved well out from the median line. If an abdominal incision is to be made in any locality other than the median line, the nurse is so instructed, and varies the site of shaving accordingly. After shaving, the skin is thoroughly scrubbed with a gauze mop. If the patient is a nervous, delicate, refined woman, the shaving would best be done on the operating table when she is unconscious.

The nurse now suspends the preparation while she disinfects her own hands, after which the skin is thoroughly rubbed and washed with alcohol, then ether, and finally with a 1:1000 mercuric chlorid solution. A large sterile gauze shield is tied by conveniently placed tapes over the

abdomen, and the patient's toilet is completed by putting on a clean nightgown. If she is nervous or feels weak, a wine-glass of sherry or a small milk-punch is given.

The first step toward disinfection in any abdominal case, after the patient is put upon the table and placed under anesthesia, is the thorough cleansing of the vagina, by raising and separating the legs and applying soap and warm water vigorously, with a pledget of sterilized cotton held in the grasp of a pair of long dressing forceps. This step need not be carried out in a young woman with an intact hymen. A large funnel or an open speculum may be placed between the thighs close to the body to facilitate drainage of fluids which run down from the abdomen on to the pad. The patient's clothes are drawn well above the upper border of the pad, her arms are flexed and folded on the chest, and retained in this position by the undervest being pulled up over them, and by tying the wrists together with a gauze bandage. The chest is protected by a blanket with a rubber sheet over it, and the legs are warmly wrapped in a blanket and sheet in like manner. If the operation will be long, the feet should rest upon a hot-water bag, and another should be placed under the knees, and still others about the chest. For feeble patients, I use long, narrow hot-water bags encased in flannel, and reaching from the armpits to the knees.

Cleansing the Abdomen.—The temporary protective gauze bandage, before referred to, is now removed by the nurse, and an assistant, with sterilized hands, proceeds to scrub the abdomen with sterilized cotton balls enveloped in gauze, applying soap and water freely for several minutes. Special care should be observed, both in the preliminary preparation in the ward and upon the operating table, in cleansing the folds of the umbilicus, when it is deep, using absorbent cotton held in forceps. Following the soap and water, the abdomen is scrubbed with ether, and after this with alcohol, and finally with a mercuric chlorid solution (1:1000). Before disinfecting the abdomen of unusually fat women, the creases formed by the overhanging cutaneous folds should be inspected for a slight dermatitis or eczema, which often exists. Unless the operation is imperatively demanded, these areas should be entirely healed before an incision is made through the abdomen, as such apparently insignificant surface lesions may conceal virulent organisms.

Arranging the Field of Operation.—Sterilized towels are now laid upon the rubber sheets on the chest and thighs and on the sides of the abdomen, completely covering them; a piece of sterilized gauze,

four layers thick and 1 meter (1 yard) square, or a sheet made for the purpose with a hole in the middle, is laid over the patient from breast to knees; finally, two sterilized towels are spread above and below over the ends of the cover. A wire bracket resting on the patient's thighs and covered with sterilized towels serves as a convenient receptacle for the instruments which the operator needs to have close at hand if the operation is done with the patient in the horizontal posture. I provide for this when the pelvis is elevated by turning over the end of a towel stretched across the thighs, and clamping it to the sheet so as to make a shallow pocket, in which the instruments rest.

Joseph Price's Method in Abdominal Preparation.—The method of preparing for abdominal section employed by Dr. Joseph Price, of Philadelphia, is as follows:

The patient is given a hot soap-and-water bath, the skin of the body being thoroughly scrubbed with the bath-brush; a shampoo is given and the nails are manicured; the field of operation is thoroughly scrubbed with soap and water; this is followed by turpentine; and this in turn by alcohol. A gauze towel is now wrung out of an acid solution of mercuric chlorid, placed over the field of operation, and left in this situation beneath the bandage, overnight. The site of incision is painted with iodin (MacDonald's method) to lessen the tendency to stitch-hole abscesses.

This thorough external and internal preparation would cause many patients, in some countries, particularly the Orient, to leave the hospital in fear of the operation. And even in our own country it not infrequently happens that thorough purgation and rest will so relieve patients suffering from tubo-ovarian disease that they will refuse operation, only to return later when the bowel is again distended and the pelvic organs again congested.

In India some good surgeons avoid extensive preparation of their patients because of the alarm thus induced.

Careful or severe preparation of patients favors comfortable and speedy convalescence, and a total absence of many of the uncomfortable postoperative complications, such as distention, persistent nausea and vomiting, scant renal secretion, elevation of temperature, sleeplessness, and other conditions which are thought to indicate the employment of opium.

Nicholas Senn's Method of Disinfection of Field of Operation or Injury is as follows:

"In important operations I have relied for several years on turpentine in preparing the surface for the antiseptic solution. After a thorough cleansing with soap and water the skin is bathed with turpentine for a minute, when warm water and potash soap are used to remove the turpentine, after which the surface is ready for the efficient use of the antiseptic solution. Next to soap and hot water the razor is most important in disinfection of the surface of the skin preparatory to the application of the antiseptic solution. The razor not only removes hair, but also scrapes away the superficial layer of the epidermis, softened and macerated by scrubbing with hot water and potash soap. In operations of choice the skin may be properly prepared for a more efficient use of the razor and brush by applying to the surface to be prepared a soft-soap poultice for a few hours. This preliminary measure to macerate the skin is of special importance in preparing the scalp, scrotum, hands, and feet for operation. One of the commonest faults in preparing the surface for operation is that the disinfection is not carried far enough. For instance, in the treatment of compound fractures of the skull it is not an unusual practice to limit the shaving and disinfection to the site of the wound. In all operations on the skull the whole scalp should be shaved and disinfected. Women usually protest against such a procedure, but when informed that this is done as much for cosmetic as for surgical reasons, the objections are overcome. Every patient can expect a fair growth of hair before he recovers from the effects of the injury or operation. Disinfection for an amputation of the breast should include the whole chest and the shoulder and arm on the side of the breast to be removed. In abdominal operations the whole abdomen, including the pubic region and the chest as far as the breasts, must be prepared. In amputations of the leg, the leg from the seat of injury or disease and the thigh must be shaved and disinfected. In amputations of the thigh, the pelvis on the corresponding side is included in the preparation. In operations for hernia, the abdomen as far as the umbilicus, the scrotum, penis, and the groin constitute the field of operation requiring disinfection.

"In operations of choice the disinfection should be made the day preceding, and the field of operation covered with a compress wrung out of a hot antiseptic solution, either a 2.5 percent of carbolic acid, or a 1:1000 solution of mercuric chlorid; moisture and heat are retained by applying around the compress a ring of absorbent cotton and over it guttapercha tissue or waxed paper, and the whole held in place

by a gauze bandage. The disinfection is repeated after the patient is under the influence of the anesthetic and before he is placed on the operating table. In emergency operations the disinfection is done after the patient has been placed under the influence of the anesthetic, to avoid delay and prevent one of the causes of shock.

"DISINFECTION OF MUCOUS SURFACES is still more difficult than of the skin. As a rule, complete asepsis cannot be secured by any of the methods in use at the present time, and in consequence of the incomplete disinfection we are generally forced to abandon all attempts to obtain primary union of the wound throughout. Irrigation of the vagina or rectum with any of the more potent antiseptic solutions has no effect whatever on the bacteria, and, besides, by doing so we incur the immediate risk of serious, if not fatal, intoxication by the rapid absorption from the mucous surfaces of the toxic agent contained in the solution. In the disinfection of mucous surfaces mechanical measures must be relied upon in preparing the parts for the operation, followed by the use of mild nontoxic solutions, such as Thiersch's solution or a saturated solution of boric acid." ("Practical Surgery," by Nicholas Senn, W. B. Saunders & Co.)

Treves' Method of preparing the site of operation is as follows:

THE PREPARATION OF THE SKIN.—"Care should be taken that the patient's body is clean. This is a surgical necessity of the utmost importance. A warm bath the night before the operation is desirable whenever possible, and a source of comfort to the patient. If time permits, the operation area should be repeatedly washed for some days before the operation. Some hours before the patient is brought to the theatre the skin of the operation area should be specially treated with a view to removing or rendering harmless the ubiquitous micrococci. The following is one of many plans followed:

"1. If a hairy part, the skin should be carefully shaved.

"2. With soap and hot water a thorough mechanical cleansing should be carried out. This, however, will not destroy germs in the epidermis or remove fatty matter.

"3. With ether or turpentine the skin is well rubbed, and again washed with soap and water. Sterilized nail-brushes should be used if possible, but where the skin is tender or thin this cannot be done. 'Rubber-sponges' are very convenient. Turpentine is more irritating than ether, and the latter should be used by choice.

"4. With gauze or wool sponges soaked in an alcoholic solution or

carbolic acid (1 in 20), or bichlorid of mercury or mercuric potassium iodid (1 in 500), the part is rendered really aseptic. A mixture of 1 in 20 carbolic acid and 1 in 500 bichlorid of mercury is very efficient, but the solution must be made with alcohol and not with water. The mercuric potassium iodid solution 1 in 500 in rectified or methylated spirit has many advantages. It is very easily prepared, it is less toxic than corrosive sublimate; it does not corrode plated instruments, and it neither roughens nor irritates the skin. Its germicidal powers are equal to those of corrosive sublimate.

"5. Moist, sterilized gauze or lint (soaked in a 1 in 60 solution of carbolic acid) should then be applied under waterproof tissue, bandaged on, and not touched until the patient is on the operating table. It is easy to attach undue importance to this antiseptic compress. It merely protects the part, and so macerates the skin that the surface epithelium can be rubbed off at the last moment. Aqueous solutions are practically powerless against organisms in the epidermis.

"6. When the compress is removed, immediately before the actual incision is made, it is a useful precaution to go over the area again with the alcoholic solution mentioned above. Finally, the skin is wiped dry with sterile swabs. In certain regions, such as the scrotum or eyelids, this cannot be done, and it may be said that it is impossible to render the scrotum really aseptic. The axilla is also a most difficult region to make surgically clean." ("Operative Surgery," Sir Frederick Treves, Lea Bros. & Co.)

Keen's Method of Preparation for Cerebral Operations is as follows:

It is always of the utmost importance that the head should be shaved. This will often reveal scars, etc., hitherto unsuspected, and no definite diagnosis should ever be reached or an operation determined upon without this procedure. The *fissures*, so far as is necessary, may be marked out on the shaven scalp by means of an anilin pencil, which is itself antiseptic. The day before the operation the head should be shaved anew, if need be, scrubbed with soap and water, next cleansed with ether, and then a moist bichlorid (1:2000) dressing applied. The dressing should be retained in place until just before the operation, when it should be removed and the disinfection repeated. Of course, the general preparation of the patient, as regards rest, diet, bathing, and the bowels, has been attended to as before any major operative procedure. In emergency cases, however, the entire preparation must usually be done under

anesthesia, but here, as before, the entire scalp must be shaved, and the scalp cleansed, as above, with scrupulous care.

Ochsner's Method.—"The important point in preparing a surface for operation lies in thorough washing with soap and water; anything that is done beyond this is of little importance, provided the washing process has been done carefully and thoroughly. In my practice the steps taken in preparing the field of operation are as follows: (1) thorough scrubbing with soft soap and warm water, with a moderately stiff brush; (2) washing the surface with a piece of aseptic gauze with fresh water, because the epithelial scales which have been loosened with the brush are easily removed in this manner; (3) soaping and shaving the field of operation; (4) washing again with aseptic gauze and sterilized water; (5) washing the surface with commercial, *i.e.*, about 95 percent alcohol; (6) washing with a solution of corrosive sublimate, 1:2000. There is still a distinct superstition in favor of the use of some antiseptic fluid for washing the field of operation, and so long as the fluid employed is harmless, I believe we are justified in using it. If this preparation of the patient is made just before beginning the operation, it will suffice; if made on the day before the operation, the surface must be protected against reinfection during the intervals. This can be done by applying sterile cotton or gauze to the surface, holding it in place by means of a carefully applied bandage. Just before the operation the surface is once more washed with a piece of sterile gauze saturated with alcohol, and is then ready for operation." ("Clinical Surgery," A. J. Ochsner, Cleveland Press.)

Preparation of the Field of Operation by Means of a Germicidal Depilatory.—Robert T. Morris's method is as follows:

Excepting on the face, Morris prepares the field of operation with a germicidal depilatory, and no other special preparation. This is applied five minutes or so before the operation. There are two depilatories which are quite effective: Foral, imported from Germany, consisting of the sulfids and oxids of calcium and zinc; and sulfur starch, consisting of the sulfids of calcium, sodium, barium, and zinc. The former preparation, being a powder, is mixed with a little water and applied directly to the parts. After three or four minutes it is removed by a soft piece of gauze wet with sterile water. The sulfur starch is all ready to apply, and for that reason it is chosen by his nurses. He has discarded the old or more elaborate preparation for operation. Both the above preparations being powerful germicides, the field of

operation can be prepared thoroughly and rapidly after the patient is on the table and under ether.

FINAL CONSIDERATIONS.

That depilation is preferable to shaving, especially for women, admits of little argument. The author has been using the method now advocated by Morris for several months with such satisfaction that his nurses would not like to go back to the old method of shaving and other elaborate preparations for operation.

The depilatory we prefer is made after the following formula:

Crystallized sodium sulfid,..... ℥iij
Unslacked lime (fresh),..... ℥x
Pulverized starch,..... ℥xj.

Reduce each separately to a fine powder. Mix and keep dry in a well-stoppered bottle. When required for use, by the addition of a little water a paste is formed, which is spread upon the parts about $\frac{1}{8}$ inch thick, by means of a spatula or thin-bladed knife. After waiting four minutes the parts are flushed with sterile water, after which, in laparotomies, we use a solution of corrosive sublimate followed by alcohol.

Solutions to be Used in the Peritoneal Cavity.—Dr. Joseph Price, of Philadelphia, says: "Early in the history of the surgery of infectious or septic or suppurative forms of peritonitis a variety of solutions—boracic acid, carbolic acid, mercuric chlorid, hydrogen dioxid, oxygen, etc.—were employed within the peritoneal cavity. Most of these have gone entirely out of use. Hot tap-water or distilled water gives the best results. Lawson Tait used hot tap-water. I employed for a long time distilled water, but this was found inconvenient and expensive, and now I am content with hot tap-water. Hot salt solution has been quite generally adopted, but in my opinion its employment in large quantities in the peritoneal cavity does not give as good results as does the use of boiled water. In abdominal work surgeons are now not doing so many complete and heroic operations as formerly. In too many instances they are practising puncturing, or incision and drainage, and are not removing the pathologic specimens; in short, they are not doing the complete and thorough abdominal surgery that they did a few years ago; hence the employment of salt solution gives fairly good results, but it is still inferior to boiled water.

" Formerly it was the rule to free adhesions when not too far advanced

or when freeing could be done without injury to the bowel, and to seek for cheesy foci and cleanse them, using iodoform and drainage. Then better results were obtained than in the more recent practice of aspiration, simple incision, and drainage. But in conditions requiring the more heroic operations, such as perforation from tuberculosis, typhoid ulcer, duodenal or gastric ulcer, ruptured gallbladder, or leaking hepatic abscess, sterilized water does the cleansing without favoring irritation of the bowel peritoneum and consequent adhesions.

"Postoperative intestinal obstruction is now more common, following douches or irrigation with hot salt solution. The hot salt solution appears to be really *too good*—it favors arrest of infection or sepsis, but the irritative action causes healthy adhesions between various parts of the bowel. I have had to reopen three patients some days after the primary operation, at which time salt solution irrigation was employed, and which seemed to be the whole cause for the intestinal obstruction. The patients were apparently doing well when suddenly obstruction developed. It is interesting and pleasing to note that about all such reopened patients recover. I have noted recently that a few operators have reported having to reopen patients a second and third time, and yet they still favor irrigating with salt solution."

As to Drainage.—Dr. Joseph Price says that "the confidence of the profession is beautifully illustrated, by multiple openings fore and aft, when the operator finds infectious foci, abscesses in the region of the gallbladder or liver, neglected perforations, and perforative conditions; in short, in those situations in which mild-mannered, ecclesiastical surgeons have permitted the 'pathologic fluids to gravitate to a safe place in the peritoneal cavity.'

"Some good surgeons employ iodoform gauze in pelvic and abdominal work. It is in puerperal lymphangitis, as a pelvic drainage or pack, that it should be used. Prior, who did the best work along this line, got almost specific results from its employment.

"Sterilized surgical gauze is the most valuable drain or dressing ever given to surgery. Some surgeons do a drain operation by using it throughout the operation to dry the surgical field. The same surgeons object to drains and only employ such methods occasionally, where local conditions are filthy and necrotic, and where they wish to quarantine local points of infection. In sterile gauze they have just what they need—gauze to gill-net the germs.

"Gauze also compensates for incomplete and imperfect methods in

operations for resection and anastomosis, operations about the gall-bladder, for gastric and duodenal ulcers, and in pancreatic and hepatic surgery. In such situations sterile gauze cofferdams offer admirable protection, and they favor results which as yet cannot be attained by other known means. The reports of splendid work being done throughout the country beautifully demonstrate the correctness of the above statements.

"Patients suffering from gangrenous, bad-smelling, septic conditions about the head of the cecum are nearly all saved by the 'open method of treatment.' A few years ago they were almost all lost. A few years ago the best surgeons in this country admitted on public stages that they could not save patients suffering from dirty and infectious peritoneal cavities. In recent discussions they have admitted that they have saved fifteen and sixteen consecutive cases of perforating forms of disease, with every known variety of germ infection. This all speaks well for a good-sized opening in the peritoneal cavity, a wet or dry toilet, a gauze pack, single or multiple drains, or no drains at all."

CHAPTER II.

POSTOPERATIVE WOUND SUTURE, DRAINAGE, AND DRESSINGS.

POSTOPERATIVE GANGRENE FOLLOWING AMPUTATION FOR CRUSHING OF FOOT AND ANKLE.

PLATE I.

CHAPTER II.

POSTOPERATIVE WOUND SUTURE, DRAINAGE, AND DRESSINGS.

Postoperative Wound Suture.—Before closing the incision of any ordinary wound all oozing points should be carefully checked, either by means of hot saline solution or ligated with fine catgut, and all hanging, ragged, or fatty tissue, liable to necrosis, should be cut away. If the incision is to be completely closed, the surgeon should endeavor to bring all the raw surfaces in exact apposition with those of the opposite side, and so arrange the deep and superficial layers of tissue as to avoid so-called "dead spaces" in which serum or blood may accumulate. For the buried sutures, catgut is preferable to any other material. Many surgeons make free use of silkworm-gut, silk, or even silver wire, but they frequently cause postoperative annoyance on account of their nonabsorption, and should seldom be used for this purpose. The double catgut ligature method as employed by Senn for all large arteries, is preferable to any other method. We still prefer silk, however, as a ligature on the femoral or other large arteries, but in no instance has secondary hemorrhage occurred in any of the lesser arteries in which this double ligature method has been employed. In closing abdominal incisions the peritoneal surfaces should first be united by a continuous catgut suture, after which it is our custom, in order to avoid hernia, to insert a row of through-and-through silkworm-gut sutures, including the entire thickness of the abdominal wall and upturned edges of the peritoneum, using double-needle sutures and inserting them from within outward, at least $\frac{1}{2}$ inch from the margin of the wound, and $\frac{3}{4}$ of an inch apart. (See Plate II.) If, now, there are indications that tension will be unusually great, "stitches of relaxation," or the button sutures, introduced by Lord Lister, may be employed with advantage, though rarely required. A needle threaded with stout silver wire is inserted through the skin several inches from the edge of the underlined flap at the outer limit of the underlining, and the free edge of this is attached to a button. The wire is then carried across the wound under the tissues, and the needle brought out through the skin at the

corresponding spot on the opposite side where the underlining ceases. The wire is then threaded to a second button, which is pushed as far down as possible, when firm traction is made on the wire, and the latter sutured in place.

After the silkworm-gut sutures have been inserted as before described, but not tied, the different layers of tissue, fascia, or muscle are sewed separately (see Plate III) with pyoktanin catgut, and special care is taken to prevent these sutures being drawn too tight or inserted too closely together, for sometimes even slight tension will produce necrotic tissue, and later suppuration from pressure of ligatures alone.

Lastly, the silkworm-gut sutures are carefully tied, and the gaping skin edges are closed by a continuous buttonhole or blanket suture of fine horsehair. (See Plate IV.)

The silkworm-gut sutures hold all the deeper parts as well as the adipose tissue firmly together, while the horsehair sutures carefully approximate the skin edges. A small strip of iodoform gauze, one or two layers, is now fixed upon one side of the wound with collodion, and when it is dry the skin on the other side is pressed inward toward the line of incision, and the free end of the gauze strip is fastened with collodion. The incision is now ready for the external dressings. The closure of the skin edges of abdominal wounds or incisions by means of a continuous subcuticular silver wire or single strand of silkworm-gut, as recommended by some surgeons, is an unnecessary refinement in abdominal surgery. Such an attempt to unite skin wounds is more applicable to wounds of the face, and even here it is better surgery to unite the deeper tissue if necessary with fine buried catgut, and close the skin edges by means of sterile zinc oxid adhesive strips. By this means the epithelial edges are closely approximated and stitch marks are absolutely avoided, so that only a very delicate linear scar is left, which after a few months becomes quite unnoticeable.

Irrigation of Wound During Operation.—In all aseptic operations irrigation of the wound or douching the wound from time to time has long been abandoned except by English surgeons. For the removal of blood-clots, to prevent oozing, or when, for any reason, irrigation of the wound before closing may seem required, careful sponging with hot normal salt solution is all that is required, and preferable to lotions of carbolic acid or mercuric chlorid. Ochsner's idea of keeping the wound as dry as possible is commendable, and should be strictly adhered to when possible. In operations under septic difficulties, when a cavity

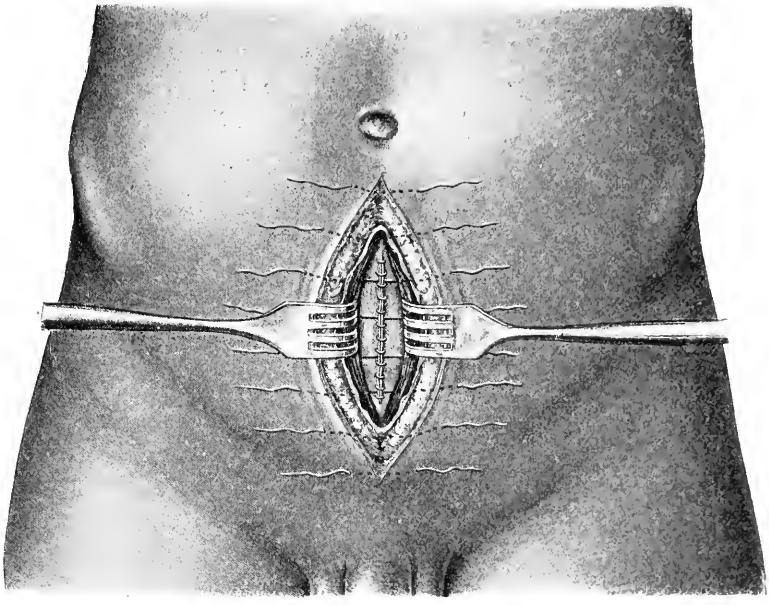

PLATE II.—CLOSURE OF MEDIAN ABDOMINAL INCISION.

The illustration is intended to show the peritoneum closed by a continuous catgut suture. The deep silkworm-gut sutures are next inserted from within out, extending through all the tissues, including the upturned edges of the peritoneum, but are not tied until the final closure of the incision.

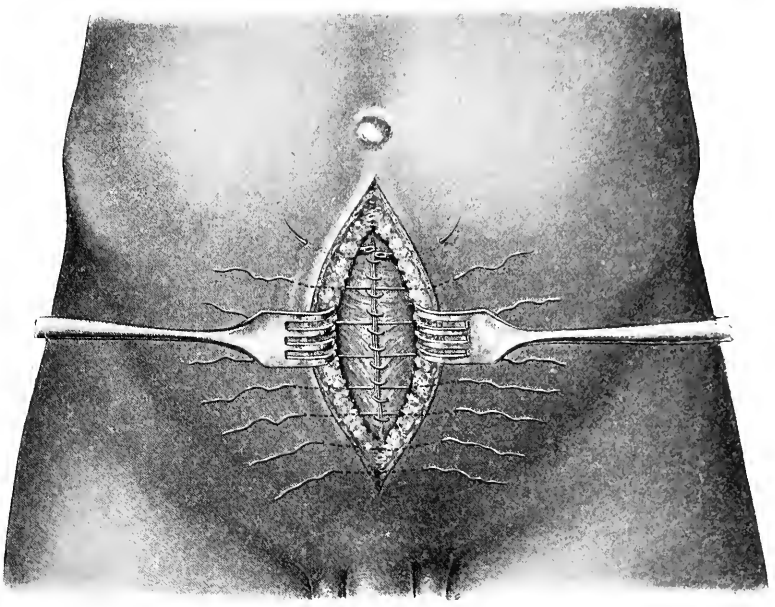

PLATE III shows COMPLETE CLOSURE OF THE TRANSVERSALIS FASCIA, CONNECTIVE TISSUE, AND RECTUS MUSCLES BY INTERRUPTED BURIED CAT-GUT SUTURES.

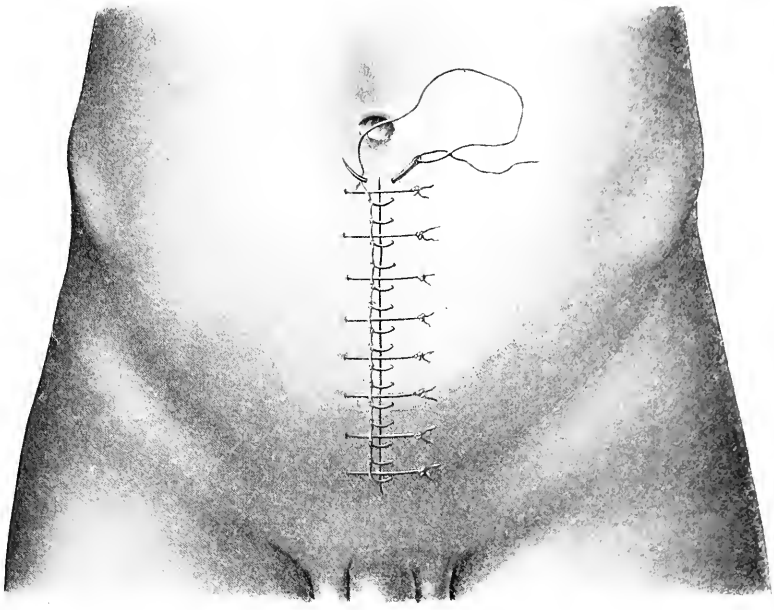

PLATE IV ILLUSTRATES THE FINAL CLOSURE OF THE INCISION.
The silkworm-gut sutures are first carefully tied, after which the skin edges are carefully closed by a continuous buttonhole stitch of fine horsehair.

contains pus or blood, it is frequently important to irrigate thoroughly, but very gently, at the time of operation, with either hot normal salt solution, 1:40 to 1:20 carbolic acid solution, or weak sublimate solution of 1:4000 or 1:3000, if for any reason it is deemed preferable.

Drainage.—Theoretically, a perfectly aseptic wound may be closed completely without drainage of any kind, and this practice may, in many instances, be followed by complete success. It can be accomplished uniformly, however, only at the expense of a large amount of time devoted to the permanent checking of all hemorrhage, however slight, and by very complete and time-consuming attention to the obliteration of all dead spaces. (Warren.)

All incised tissues exude a certain amount of serum, and there are few wounds, no matter how carefully attended to, which are not followed by more or less subcutaneous blood oozing. In a small proportion of cases at the time of closure the wound may seem to be absolutely free from bleeding, but one or more vessels will, after closure, permit some hemorrhage into the tissues. The passing of pure serum or blood into the cellular spaces of a wound is certainly an invitation to bacterial development, which in a perfectly empty wound would not take place. Carefully applied drainage, in one form or other, provides against the accumulation of serum or accidental bleeding into the tissues and reduces to a minimum the chances of infection. Drainage, therefore, should be applied always to wounds, even in those which presumably are aseptic, in order to remove any possible blood exudation. In aseptic wounds very small pieces of gauze will answer the purpose above mentioned, and may be removed within a few hours, or at the first convenient opportunity. This temporary drainage material should be removed, as a rule, within twenty-four hours, or not later than forty-eight hours, following the operation. All superficial aseptic wounds, as well as large and deep ones, may be perfectly drained if the surgeon introduces at one or two points a narrow strip of guttapercha, which should pass from the surface to the deepest portion of the wound that requires emptying. Such strips can be readily placed by means of a probe before closure of the wound. They should not be more than $\frac{1}{4}$ to $\frac{1}{2}$ inch in width, and should project above the surface about one inch. Serum will find its way out by the side of them. These strips of guttapercha never leave a prolonged sinus, even when left in place for some time, and the wounds to which they are applied heal with great rapidity. (Excerpt from "International Text-book of Surgery," vol. i.)

Of the various forms of drainage, india-rubber tubing is usually the most convenient; but, instead of this, tubes may be made of absorbable bone, glass, or metal. Soft-rubber tubes should always be given the preference when there is little liability to compression of the tube. When compression is liable to occur, glass is the most suitable material, especially in pelvic and abdominal cases. In the ordinary septic cases requiring drainage, in pus-cavities, etc., or in severe collapsible wounds, such as are formed by coils of intestines, gauze drainage, or, preferably, gauze rolled in rubber tissue cloth, is occasionally of great value especially when capillary drainage is desirable. It is used, however, only after septic operations, or in those which, from their nature, are liable to become septic. All septic wounds should be packed carefully in order that the gauze surface may lie in contact with every portion of the wound, so that all liquid may be drained off in the outer dressings. The external opening must invariably be wide and free. The drainage-tube, as a rule, may be removed after the first forty-eight hours, unless specially contraindicated by a continuance of the discharge. A good plan is to pass a stitch through the skin on each side of the tube, allowing it to remain untied until after the tube is removed. This will bring the parts in better apposition later. When positive that there will be little or no oozing and the wound is strictly aseptic, we frequently place one or two layers or small strips of iodoform gauze over, covering the entire length of the incision, and seal this with collodion. If a large cavity in the abdomen has been plugged by the use of medicated gauze, four to six days should elapse, or even longer, before attempting its removal; and when the gauze is being removed, it should be wet from time to time with hydrogen dioxid, which renders it antiseptic and permits it to be more easily and less painfully removed.

This does not apply to cases of acute necrosis of bone. When a bone cavity has been packed with gauze, the packing should be removed in twenty-four to forty-eight hours. As this is frequently very painful, an anesthetic may have to be employed.

Dressings.—Essentials requisite for good wound-dressings are that they shall be absorbent, *i. e.*, favor drying which interferes with germ-growth, and that they shall contain germicidal substances preventing infection of the discharges, which in turn may reach the wound. Both of these properties render frequent dressing unnecessary, thus giving rest to the wound. Many kinds of antiseptic gauzes are used—iodoform, carbolated, sublimated, or borated gauze fulfil all indications.

Kocher, however, prefers xeroform, others prefer nickel, formaldehyd, mercury bicyanid, etc. "Sterilized iodoform gauze 5 percent, the strength now ordinarily used, promotes drying of the secretions, and if sepsis occurs, will help to destroy the resultant ptomains." (Dennis.) Carbolized gauze of the strength of 2 percent, sublimate gauze of 1:2000, or plain sterilized gauze may be used, and should be placed loosely over the entire wound; over this a layer of sterilized absorbent cotton, wool, oakum, etc., held snugly but comfortably in place by properly applied bandages, tends toward maintaining rest of the parts, promoting drainage, and relieving the strain upon the stitches.

CHAPTER III.

POSTOPERATIVE COMPLICATIONS.

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Postoperative High Temperature.—Systemic reaction follows as a natural consequence all major operations, aseptic or otherwise. A few hours after the patient has recovered from the effects of the anesthetic there is always more or less elevation of temperature. The exact cause of this transitory fever has not been fully determined. It differs materially from surgical fever, has no relation to infection when moderate in degree, and hence should cause little anxiety to the attending surgeon. This elevation of temperature is termed by Volkmann "aseptic wound fever"; by von Bergmann, "fermentative fever"; by Billroth, "resorption fever," or "after-fever"; and by more recent surgical writers, "simple traumatic or primary fever." The term "systemic reaction" seems to me more suggestive of the exact condition than any of the names given, however complicated the pathologic conditions accounting for the same.

Symptoms.—This form of postoperative fever in aseptic cases rarely lasts more than forty-eight to sixty hours, and seldom exceeds 102° or 103° F. The rise of temperature is gradual, without rigor or other indications of infection. The pulse usually increases in proportion with the rise in temperature, and when the reaction is over, the temperature and pulse become normal or nearly so, and thus remain throughout convalescence.

Treatment.—Postoperative or reactionary fever requires very little treatment. One dram of the fluid extract of couch-grass in one or two ounces of hot water, with 15 to 20 drops of sweet spirits of niter three or four times a day, will tend to allay thirst and increase diuresis and diaphoresis.

Postoperative Diarrhea.—Postoperative diarrhea is either the result of indiscretion in diet or an indication of septic infection. If due to the former, a laxative of castor oil followed by bismuth subgallate is ordinarily sufficient to overcome the trouble. If, however, the diarrhea is the result of septic infection, more active measures are necessary.

All pus-cavities, wherever situated, must be drained, and all other means to overcome sepsis must be immediately resorted to. In the adult, 15 grains of beta-naphthol bismuth should be administered in capsules every four hours, or, if a child, large doses of bismuth subnitrate (10 to 20 grains) with tincture of geranium are preferable. If the temperature is persistent and high, subcutaneous injection of antistreptococcic serum is often of great value.

Postoperative Infection.—It is not within the province of this work to discuss surgical bacteria, nor the form and character of the various infective microorganisms which create postoperative or surgical fever. Clinically, it is frequently difficult for even the expert to distinguish between the various forms of septic infection or intoxication; therefore it would appear impracticable to attempt to draw a sharp line between septicemia, pyemia, and other forms of septic infection. Neither theory nor practice justifies such a distinction, since the pathogenic organisms are the same in each of these conditions, the morbid anatomic changes vary more in degree than in kind, and the clinical signs do not enable us to distinguish unerringly between them. This inability to separate these forms of infection is frequently due to the fact that typical cases are seldom seen. The type usually found is of a mixed character, and often obscured by other disturbances which prevent one not an expert from recognizing the exact character of the systemic invasion. Pyemia no longer means, as its etymology implies, pus in the blood. By pyemia we now mean a form of blood-poisoning by pyogenic organisms, in which living bacteria are transported by the blood to distant tissues, where they multiply and produce abscesses; so that in pyemia the production of multiple abscesses is the typical pathologic phenomenon, just as in septicemia the dominant feature is the systemic intoxication with living bacteria in the blood. "Septicopyemia" is a clinical term used to convey the impression that the symptoms of sepsis are as well marked as those of pyemia. (Warren-Gould.)

I shall, therefore, describe under this one heading of "postoperative infection" the ordinary symptoms of systemic infection or blood-poisoning as commonly seen and recognized by the terms septicemia, pyemia, and septicopyemia so far as they relate to or follow surgical operations.

Symptoms.—The symptoms of septicemia differ in intensity with the extent and character of the infection. The symptoms may be very mild

and last but a few hours; on the other hand, if the seat of suppuration, from improper drainage or after supposedly aseptic operations, necrosis of tissue with suppuration from stitch-pressure makes its appearance as a result of improperly sterilized articles used during the operation, the symptoms may be so pronounced as to endanger the life of the patient. Again, if extensive surfaces capable of rapid absorption are suddenly flooded with infected fluids, toxemia follows rapidly, and death may quickly follow. For example, in operations for appendicular abscess, or upon a gallbladder containing pus, which is accidentally incised or is ruptured into the abdominal cavity, death frequently follows within a few hours. The ordinary symptoms of infection usually appear within from five to six days following operation. The sudden rise of temperature to 103°, 104°, or 105° F., preceded by a slight chill, should always be sufficient notice to the attending surgeon of infection and impending danger, and it demands prompt attention. These symptoms, if neglected, become more and more pronounced; the patient feels hot, or there is a condition of alternating heat with chilly sensations. The skin, lips, and mouth are dry; urine becomes scanty and of a high color; the pulse becomes weak and rapid, and there is always more or less general disturbance. The patient becomes restless, the face has a flushed, anxious look, the temperature is always higher at night with morning exacerbations, sleep is troubled and unrestful, and there is usually delirium. The symptoms, unless relieved, assume more and more a typhoid condition; nausea and vomiting, with profuse diarrhea, extreme exhaustion, and depression of the vital forces, are now prominent symptoms. The tongue becomes dry and brown, and even cracked; the breath is often foul; the perspiration from the body of the patient becomes sour, pungent, and of a disagreeable odor; delirium is well marked, and the patient passes into coma. Movements from the bowels and kidneys become involuntary, the temperature continues to rise, pulse becomes more and more rapid, and death is ushered in by failure of respiration.

This slow form of septicemia may continue for several months, as every surgeon of experience can testify. Marasmus may increase to such an extent that the patient is reduced to a pitiful degree of physical debility, from pent-up pus. Should living pyogenic organisms, by means of the pus, enter the blood, and be thus carried to various parts of the system, we will have the condition known as pyemia, which differs from septicemia only in the formation of metastatic deposits. The typical cases of pyemia are easily distinguished clinically from septicemia by

the finding of these secondary abscesses; and, in addition to the symptoms already described, we have marked rigors, followed by profuse sweating. The occurrence of these symptoms announces to the attending surgeon that the elements of pyemia have been added to those of septicemia. The surgeon must ever bear in mind the important fact that, no matter what the character, extent, or locality of the operation or whether it be five days, ten days, or two weeks following the operation, a sudden rise of temperature to 102° or 104° F., with or without a severe chill, and corresponding disturbance of the circulatory system, always denotes infection and demands prompt interference. The condition requires the immediate adoption of drainage, or if drainage has been employed, it requires that it should now be more thorough. These signs are positive, hence delay is inexcusable. The temperature-record is nearly always characteristic of septicemia. The morning temperature is lower and rises to the maximum only at night. In pyemia, rigors, often severe, followed usually by profuse sweating, are the outward manifestations. The nervous system is at times stimulated by sepsis, so that the patient does not realize his own jeopardy. (Warren, "Surgical Pathology.") But usually, especially after the first few days, the patient is restless or inclined to be in a state of stupor.

Treatment.—In all cases of postoperative infection, septicemia, pyemia, etc., an attempt should be made to ascertain the source of infection, and all efforts directed not only toward the support of the patient, but the elimination of the toxins and microorganisms from the body. The patient's bowels must move properly, the kidneys act freely, and no intestinal putrefaction should be allowed to remain. It is often necessary to support the patient's strength from the first; hence a generous diet should be given, and so soon as the pulse begins to fail, free stimulation will become necessary. All wounds should be opened, and after thorough irrigation with an antiseptic solution, drained freely. Antistreptococcic serum is often of the greatest value. A combination of quinin, 3 grains, with phenacetin, 5 grains, every three or four hours, may likewise prove of utility. Should typhoid symptoms supervene, the treatment, as in all other exhausting diseases, should be directed to the support of the patient's strength by nourishing food, tonics, and stimulants. Antipyretics should usually be avoided, for the reason that they frequently act as cardiac depressants; excessive temperature should be overcome by cool sponge-bathing. According to Billroth, a most important medicinal agent to combat septic infection is alcohol. It is

borne by patients in large doses and appears to exercise a favorable influence upon the course of the malady. It should be administered in the form of brandy or whisky. In egg-nog, egg-flip, etc., we have a ready means of combining this agent with food. With peptonized milk and eggs, the alcohol may be introduced in clysters when the stomach fails. (Warren.) Digitalis is reserved until the pulse weakens, but strychnin, pushed almost if not quite to the physiologic limit, now enjoys a wide and apparently well-deserved popularity as a tonic stimulant. Feeding is just as important here as in typhoid fever, and it is the attendant's duty to see that a regular plan of feeding is arranged and adhered to. When the patient can no longer digest his food, it must be digested before it is administered. (For further information upon this subject the reader is referred to the chapter on "Treatment of Septic Wounds.")

Postoperative Hemorrhage.—Postoperative hemorrhage is sometimes a matter of great annoyance, especially after amputations or operations upon pus-cavities, bones, ribs, the tongue, etc. The slipping of ligatures, faulty technic, neglect to ligate the smaller arteries or failure to stop all oozing at the time of operation, may, immediately following systemic reaction, lead to accidental or recurrent hemorrhage. This form of hemorrhage is manifest usually in from two to four hours following operations, the dressings and bandages becoming suddenly saturated with blood. The hemorrhage may be caused by capillary oozing, or may be the direct result of constitutional idiosyncrasy or disease, such as hemophilia, jaundice, or leukocythemia, etc. If the bleeding is from an artery, however small, a large hematoma may form and produce distention of the wound. In any case, all the dressings should be immediately removed, the source of the hemorrhage ascertained, and the clot, if present, removed. If the bleeding is from a vein, all constriction above the wound must be removed before the hemorrhage will cease. If the hemorrhage is not profuse, new dressings should be applied and pressure made by means of a snugly applied bandage. This will usually suffice to arrest all bleeding, especially if venous or capillary. When the bleeding point is deeply seated and when it is not desired to open up the wound, pressure may be applied in the form of a compress applied directly over the surface of the wound. If this does not suffice to control the hemorrhage, and there is evidence of exhaustion, the patient must be anesthetized immediately, the wound laid open in its entirety, and the bleeding vessel secured.

Bleeding from Bones.—In case of bleeding from bones, Horsley has introduced an aseptic wax which can be applied by firm pressure over the bleeding point so as to close the opening in the bone from which the blood comes. The composition of this wax is: Beeswax, seven parts; almond oil, one part; salicylic acid, one part. When not in use, the wax is kept in carbolic solution, 1:20. When it is required for use, a small piece is pinched off, softened by rolling between the fingers, which of course should be aseptic, and then placed into the part of the bone from which the blood is coming. The wax gives rise to no trouble in healing of the wound. (Cheyne.)

Hemophilia.—Bertrand and Pilcher contend that the danger of capital operations is greatly overrated in this class of cases, because the larger vessels bleed no more than in ordinary patients. Our experience is limited to but two cases of congenital bleeders, and if these are a fair criterion, we would certainly avoid operative measures unless absolutely necessary; but if forced to do so, would ligate carefully the most minute vessels and sear the surfaces of all raw edges with the actual cautery and close the wound, if possible, by adhesive strips instead of using needles and sutures. In cases of hemophilia, suprarenal extract given in powdered form, 5- to 10-grain doses thrice daily, has of late been highly extolled. Calcium chlorid in large doses occasionally proves efficacious, and should be tried if other styptics fail. Weil uses a 5 percent solution of gelatin as a local styptic in these cases with successful results. Wright, of Netley, introduced fibrin-ferment as a styptic for the purpose of checking excessive oozing from large raw surfaces. A piece of sterilized lint, sponge, or muslin is saturated with the ferment solution and laid upon the oozing surface, so as to come thoroughly into contact with all the bleeding points. Its action is to induce rapid coagulation of the blood as it issues from the vessels; if these are small, the result is good.

Secondary Hemorrhage.—Secondary hemorrhage, the dread of our forefathers, rarely occurs in these days of aseptic surgery. It occasionally occurs in amputations or major operations, however, as a result of the sloughing of arteries in septic wounds, especially if there is a condition of atheroma. The too rapid absorption of the ligatures, or possibly their imperfect application, may be classed as causes of this unfortunate occurrence. The double ligation, with catgut, of all larger arteries, one ligature placed about one-fourth of an inch proximal to the other, materially lessens the tendency to this complication. Secon-

dary hemorrhage may occur at any time within from twenty-four hours to two or three weeks after major amputations. About the twelfth to the fourteenth day is the time when it may be most expected. The slightest sign of fresh hemorrhage upon the bandages or dressings should be regarded as important, and requiring immediate examination. If this hemorrhage is slight, simple pressure by means of a bandage may suffice for its control. If, however, the hemorrhage is profuse, the tourniquet should be first applied, and if the wound be open, a ligature should be applied to the end of the vessel. In sloughing wounds or in a nearly healed stump it is often advisable to ligate the vessel in continuity. (Warren.)

In secondary hemorrhage following operations upon the tongue, or in cavities where it is impossible to pass a ligature, acupressure by means of a proper forceps, the needle of which passes through the tissues so as to include the vessel, may be attempted, or the wound may be firmly packed with aseptic gauze. These means failing, resort should be had to the actual cautery.

Postoperative Hemorrhage after Nasal Operations.—Hemorrhage following nasal operations is sometimes extreme and depends upon the character and extent of the operation. In case spurs springing from cartilaginous bases have been removed, simply touching the denuded area with a 10 percent solution of camenthol (Bishop) is sufficient. The same treatment will apply to many polypus operations. In cases of more persistent hemorrhage, such as in operations on turbinated bodies, spurs with bony bases, etc., packing the cavity is necessary. This packing should not be confounded with the old-fashioned "plugging." The packing should be so introduced as to prevent hemorrhage, while mere plugging closes the anterior and posterior nasal openings, permitting the nasal cavity proper and sinuses to become filled with blood if the hemorrhage is sufficient. The ideal method is to pack the entire field of operation with some substance that will prevent or check all hemorrhage without causing hard coagula, one that the operator can adjust so as to regulate the amount of pressure, or remove part without disturbing the remainder. The following method has been used with satisfaction: A strip of gauze, one-half inch wide and in length one to two yards, is folded on itself, and the end formed by the fold is tied in the middle by a heavy silk ligature. The gauze should be saturated with 10 percent camenthol solution, and after pressing out the excessive fluid, the packing is ready for use. Apply with a slender forceps under

good illumination, seizing the gauze at the point where the ligature is attached. Pass a portion of the packing well back of the seat of operation, holding the ligature at each end aside and packing between. Fill the nasal cavity as well above the bleeding surface as possible. When no more can be used, clip off the excessive gauze, grasp both ends of the ligature in one hand, place a finger against the packing to prevent displacement, and make tension by drawing upon the ligatures sufficiently to obtain the pressure desired. Lastly, tie the ligature over the anterior or exposed end of the packing, by means of which direct pressure is made upon the bleeding surfaces. The packing should be allowed to remain forty-eight hours, after which the ligature should be clipped and that portion of the packing which comes away readily should be removed. If a small part of the packing is adherent to the wound, it should not be disturbed. By keeping the nasal cavity well cleansed with a mild antiseptic solution, the remaining gauze will loosen in twenty-four to thirty-six hours, and can then be removed without causing further hemorrhage.

Postoperative Hematemesis.—The advent of hematemesis after operation is a serious complication. The mortality is high. Of twenty-nine cases already recorded, 69 percent died. The incidence of hematemesis is not associated with any particular form of operation. In the majority of instances it has followed operations relating to the abdomen. But, on the other hand, Purves has been informed of two cases in which it followed amputation through the thigh and the removal of a neuroma in an amputation stump. As a rule, there is no history of previous gastric symptoms or vomiting of blood. Chloroform-sickness may or may not precede the hematemesis, and in only a few cases can be held responsible for initiating the bleeding. In those cases in which vomiting after the anesthetic is present, it appears more usual for the hematemesis to come on gradually. In the absence of chloroform-sickness one finds that the first hematemesis is often quite sudden. In the majority of cases hematemesis sets in within forty-eight hours of the operation, though it may be delayed for some days. There may be only one or two occasions within a period of two or three hours in which blood is vomited, which is favorable; or the vomiting may continue at frequent intervals for a period of fifteen to twenty hours. In the latter instance, as a rule, there will be a fatal termination within twenty-four hours of the onset. The vomiting is generally small in quantity, though in some cases one to three pints have been ejected. It consists, as a

rule, of blackish-brown fluid, with a varying amount of bile and of digested blood. The feature of these cases that is most striking is the state of collapse and asthenia into which the patients often enter so rapidly. The condition is often a perfectly obvious toxemia from a recognizable septic infection of the operation wound. But in many cases, and chiefly in those of the greatest gravity, one is at a loss to account with certainty for the cause of the depression and rapidly advancing inanition. It is clear that all cases of postoperative hematemesis are not due to any one cause. In a certain number of cases it can be attributed, without a doubt, to gastric ulcer or rupture of a bloodvessel, when atheroma or cirrhosis of the liver is present, and in such cases it is no doubt precipitated by chloroform-sickness. Injury and a non-infected embolus from a ligated omentum may account for some cases. But the author believes in those cases in which such an explanation is not possible—and they are the majority—that the origin is of an infective nature. (Purves, "Edinburgh Med. Jour.")

Prognosis.—Prognosis is always grave. The more marked the systemic resistance, the greater is the chance of recovery. Subdued or masked infection, with subnormal temperature and rapid pulse, a rapidly increasing vital depression, the vomiting tending to become regurgitant, renders prognosis graver. If bilious vomiting appears after one or two paroxysms of vomiting blood, the prognosis is favorable.

Treatment.—The stomach should be washed out at once with a 2 percent solution of sodium bicarbonate, at a temperature of 110° to 120° F., until the fluid returns clear; to be followed by a 1: 1000 solution of adrenalin chlorid in normal salt solution. When collapse is marked, infusion of normal saline solution, with adrenalin, into a vein should be done as well, and both procedures should be repeated if there is any return of hematemesis or collapse. Strychnin hypodermatically is of value. All patients should be nourished by rectal alimentation, and no food should be given by the mouth until all symptoms have improved and the patient is in a normal condition.

Intestinal Paresis, or Pseudo-ileus.—After abdominal section we sometimes encounter a peculiar condition, frequently as unexpected as inexplicable, which has been called by some of our modern surgeons "intestinal paresis, or pseudo-ileus." This implies a form of intestinal obstruction brought about by a certain degree of muscular paralysis of the intestinal tract. The term "delayed shock" has also been used for this affection, although the ordinary symptoms of shock are seldom

present. The cause is usually attributed to prolonged intestinal exposure, but in our own experience it is seldom seen after most extensive operations, and more frequently follows minor procedures, unattended by hemorrhage or intestinal adhesions. I can find no literature on the etiology of this subject, but the more I observe these cases, the more I am disposed to consider them distinctively neurotic in character, the abnormal nerve-force or peculiar idiosyncrasy on the part of the patient being responsible in a great degree for the condition of the nervous system which permits such profound exhaustion. The neurotic element may therefore enfeeble systemic resistance to such a degree as to prevent normal reaction. I have noticed in several instances that lumbar pain, or pain at the base of the occiput, preceded the local or abdominal symptoms. Lastly, symptoms limited solely to the intestinal tract are rare. This condition of ileus is often confused with peritonitis. It differs from other cases of intestinal obstruction by its rapidly fatal course if unrelieved.

The following is typical of the condition described as intestinal ileus or paresis:

Mary S., twenty-eight years of age, brunet, medium height, slight in build, weight about 106 pounds, unmarried, seamstress. Had repeated attacks of dysmenorrhea for several years, decidedly nervous temperament, hysteric at times, of late quite despondent, appetite poor, urine scanty. Operation—fixation of retroverted uterus; anesthetic—ether. Patient took the anesthetic very slowly or tediously. Operation was simple, no adhesions or other difficulties; ovaries normal and anterior fixation was rapidly performed. Time of operation, twenty-six minutes. Abdominal wound closed by the ordinary method. No normal salt flushing. Patient recovered from the anesthesia with very little nausea. The following day she complained of thirst, but otherwise the symptoms were normal, except that the pulse was somewhat feeble. The conditions remained the same until the morning of the second day, but apparently without effect. The morning of the fourth day, about an hour after an ounce of castor oil had been given, she complained of severe pain in the back, and shortly following these symptoms the tympanitic or distended condition of the abdomen was first noticeable. There was also an inclination toward listlessness or stupor. The temperature, which had continued about normal, fell to about 98° (in the rectum); pulse became feeble and rapid. Attempts to establish catharsis failed, and lavage of the stomach was repeated several times without apparent benefit, but despite every effort the patient gradually passed into a comatose condition

and died on the morning of the fifth day. At the autopsy no apparent cause for the trouble could be found. The abdominal wound had healed by first intention.

SYMPTOMS.—The characteristic symptoms of this form of ileus or paresis are, therefore, inability to secure bowel movement, general tympanitic condition of the bowels, apparent exhaustion of the vital forces with normal or subnormal temperature and feeble pulse—symptoms usually appearing three or four days following abdominal operations.

TREATMENT.—These cases frequently terminate fatally, especially if not recognized early. Death is supposed to be caused by changes in the central nervous system, or, according to some pathologists, is the direct result of toxic effects due to the migration of *Bacillus coli communis*. Our aim must be to establish peristalsis as quickly as possible. Lavage of the stomach should be performed early, after which a rectal tube should be inserted to overcome the resistance of the sphincter ani. High rectal enemas of normal salt solution, glycerin, or soap and water should now be given; and if these fail to give prompt relief, resort must be had to purgatives, both by oral and rectal administration.

I rely, first, upon thorough lavage; second, upon calomel in one-fourth-grain to one-half-grain doses every hour, followed by a purgative of one dram of rochelle salts, repeated every two hours. High enemas of one ounce of magnesium sulfate, dissolved in three ounces of hot water to which one or two ounces of glycerin have been added, should be given every two hours until effective.* In cases in which aperient medicines cannot be given by the mouth, in consequence of vomiting, and no result has followed simple enemas, the following purgative enemas may be found of value:

1. Castor oil, turpentine, 1 ounce of each in 10 ounces of thin gruel.

2. The British Pharmacopœia enema terebinthinæ, containing 1 ounce of turpentine to 15 ounces of mucilage of starch. (Both of these preparations, however, are rather strong, and I usually employ an enema of one pint of gruel containing one to two drams of turpentine.)

3. Enema of magnesium sulfate (or enema catharticum, B. P.): magnesium sulfate 1 ounce, olive oil 1 ounce, mucilage of starch 15 ounces.

* Franklin H. Martin has called attention to the fact that glycerin sometimes acts as a violent irritant poison. He attributes two deaths to this cause when the enemas were retained. When these enemas are retained their expulsion should be favored by flushing the bowel with salt solution.

4. Enema of aloes (B. P.): Aloes 40 grains, potassium carbonate 15 grains, mucilage of starch 10 ounces.

5. Enema of colocynth contains extract of colocynth ½ dram, soft soap 1 dram, water 1 pint.

6. Enema of glycerin, 1 to 2 ounces with 1 ounce of tincture of asafetida and 1 ounce of magnesium sulfate, dissolved in 4 ounces of hot water.

In addition to the above, a solution of pepsin with diluted muriatic acid, or 10- to 15-drop doses of tincture of nux vomica every four hours, may prove of value in restoring digestion and normal peristalsis.

Wiggin ("Am. Med. Jour.," 1892, page 627) believes that postoperative intestinal paresis may be successfully overcome in almost all cases if the surgeon is on the watch for the early symptoms, and is prompt in treatment. He dwells upon the important fact that the stomach and bowels should be emptied before the anesthetic is given. If he has reason to believe that there is some tendency to paresis, and if a proper preparation of the stomach was not possible before the operation, he insists that before the patient regains consciousness the stomach shall be carefully washed out and four or five ounces of a saturated solution of magnesium sulfate be poured through the stomach-tube before it is withdrawn. If symptoms are first noted some hours after the operation, the contents of the blue paper of a seidlitz powder should be dissolved in a full glass of water, the contents of the white paper scattered upon the surface, and the patient directed to drink while the effervescence is going on. The generation of a part of the gas in the stomach will help to overcome the pressure of gas in the intestines. If the draft is vomited, a second dose should be given, and if this is not retained, the stomach should be washed out and a saturated solution of magnesium sulfate introduced. The use of a rectal tube and of hypodermatic administration of strychnin and atropin is also recommended, but the essential part of treatment is that mentioned above. Arndt ("Zentralblatt für Gynäkologie") narrates five cases of postoperative intestinal paresis, in all of which the patients recovered after the use of eserin. The preparation which the author uses is the salicylate of physostigmin, hypodermatically administered in the dose of $\frac{1}{65}$ of a grain. Usually within an hour abdominal cramps were felt, and soon after flatus was passed with a total disappearance of the serious symptoms—meteorism, shallow and rapid respirations, rapid and flickering pulse, and the appearance of collapse.

Postoperative Lung Complications.—Postoperative bronchitis, bronchopneumonia, and lobar pneumonia are rare postoperative occurrences, and when they occur, may usually be attributed directly to the anesthetic itself, or are the result of prolonged anesthesia, especially when the patient has been subject to changes of temperature or drafts during administration. Crouch, who investigated this subject at the St. Thomas Hospital in London, found in 2400 administrations of ether, ten cases of subsequent lung complications which were directly attributable to the anesthetic. Peterson ("Am. Med. Jour.," 1892, page 1075) reports two cases of postoperative pneumonia, three of pleurisy, and one of bronchitis. Such pneumonia may be infectious or due to inhalation of irritants. Bronchopneumonia is apt to follow operations on the pharynx or larynx, and the administration of an anesthetic in the extremes of life. Peterson does not agree with Prescott as to the relative infrequency of postoperative pneumonia. He uses the best Squibb's ether, and takes particular care to avoid chilling the patient during operation. In major abdominal operations he modifies the Trendelenburg position by partially elevating the head of the table after the intestines have been removed and held from the pelvis by packs. Metastatic pneumonia is more apt to occur after abdominal than other operations, especially when ether is employed. There is undoubtedly a hypostatic form of pneumonia which develops usually at the base of the lungs of a patient with peritonitis or other forms of sepsis. Pleurisy has often been overlooked on account of the pain having been ascribed to a reflex condition from below.

In operations upon the pleura, resection of ribs, etc., in which we already have extensive infection, or in paracentesis for abscess, we not infrequently have a postoperative extension of the infection, as manifested by acute inflammation of the lung and surrounding tissues. The inflammation may remain local, occasionally it extends rapidly, speedily producing suppuration and ending in gangrene of a portion of the lung.

Symptoms.—The symptoms of postoperative pneumonia depend upon the nature or extent of the inflammation, whether simple or septic, and the amount of lung tissue involved. ("International Text Book of Surgery.")

Simple localized traumatic inflammation usually causes but slight constitutional disturbance, while the physical signs will in most cases be obscured by other conditions, such as pneumothorax and hydrothorax. Spreading septic pneumonia, on the other hand, is characterized by grave constitutional symptoms; the temperature rises to 105° or 106° F.,

the pulse is rapid,—130 to 140,—and there is severe local pain. The expectoration, which is at first bright red, soon becomes rusty colored, and there is marked dyspnea. On examination of the lungs, the ordinary signs of pneumonia may be detected, viz., dulness, increased vocal fremitus and vocal resonance, bronchial breathing, and crepitation; but not infrequently these signs are obscured by the presence of fluid in the pleural cavity.

The prognosis, which, as a rule, is favorable, will depend upon the amount of lung tissue involved and on the presence or absence of a foreign body. Postoperative pneumonia shows but little tendency to spread,—*i. e.*, involve the other lobes,—and in this it differs essentially from the idiopathic pneumonia.

Treatment.—There is no routine treatment for postoperative pneumonia; on the contrary, much judgment is required to decide as to the proper management in every case. If the disease is ushered in suddenly and the clinical picture presents evidences of general acute poisoning, accompanied by rapid rise of temperature, pain in the side, restlessness, and dyspnea, indicating a streptococcus infection, antistreptococcic serum should at once be injected subcutaneously. When there is excessive congestion of the lung with great dyspnea and many coarse and subcrepitant rales over the lung, relief can be obtained by hypodermatic injection of morphin $\frac{1}{4}$ to $\frac{1}{2}$ grain with $\frac{1}{50}$ grain of nitroglycerin; and, in addition to ordinary remedies for the feeble heart, an excellent combination is 5 grains of potassium iodid, 1 minim of fluid extract of digitalis, and 20 minims of fluid extract of convallaria, given every three hours. Hot saturated solutions of boric acid, applied on sterilized absorbent cotton and changed frequently, will also afford marked relief. As a rule, the patient should be kept quietly in bed on a fluid diet until the temperature has fallen to normal and the exudate has disappeared from the lungs. If resolution be delayed, or if bronchopneumonia develop, resort should be had to iron, quinin, the mineral acids, oxygen, cod-liver oil, etc. In elderly people or old alcoholics, in whom prostration is out of proportion to the extent of the lung inflamed, resort should be had early to heart tonics, strychnin, and alcoholic stimulants.

There is a consensus of opinion concerning indications for the treatment of postoperative pneumonia. They are: (1) To relieve the toxemia; (2) to prevent failure of the heart; (3) to meet complications as they arise. To accomplish the first of these ends Delancey

Rochester (Buffalo) stimulates the skin and bowels to carry off the constantly accumulating poisons. The bowels are kept clean and frequent liquid stools secured with daily doses of epsom salts, following calomel at the outset of the disease. Free sweating is induced by hot mustard foot-baths, given at frequent intervals, the patient being warmly covered with blankets. These baths, in connection with stimulation to maintain the action of the heart, are considered the most important of the therapeutic measures. Not only do they play an important eliminative part, but by dilating the capillaries they equalize the circulation and relieve the work of the heart. To maintain the work of the heart Rochester depends mainly upon strychnin, commenced early and given in doses sufficiently large. Next to strychnin he places alcohol. In case there is evidence of failure of the right heart, he bleeds. Locally he uses leeches and cups—wet and dry.

It will be observed that the essential feature of this treatment is *eliminative*, aimed at the toxemia—the continual flushing of the bowel and the diuresis induced by the mustard baths. These, as already stated, have a second and perhaps not less important effect in that, by dilating the peripheral arterioles, they dissipate the pulmonary stasis which endangers cardiac integrity. This treatment, therefore, has a sound logical basis. ("Medical Standard," June, 1901.)

Postoperative Thrombosis.—Postoperative thrombosis is a rare complication most frequently occurring in anemic subjects, and usually makes its appearance between the twelfth and sixteenth days after the operation. The clot or thrombus which forms in the bloodvessels is due to some interruption of the blood-current at a definite point. The ligation of a bloodvessel close to the point of entrance to the main trunk is supposed to account for some cases. Thrombi are designated as venous or arterial, according to their location. The arterial is far less common than the venous. Septic or sloughing wounds occasionally throw off infected clots which may be carried as emboli by the blood to various organs or parts of the body. Schenck ("New York Med. Jour.") found that out of a total of 7130 operations, there were 48 cases of thrombosis of the veins of the lower extremities. He concluded that the different complications are therefore more common after operations on the pelvis than on any other part of the body, due to pressure upon or injury to the large venous trunk.

Treatment.—Treatment consists in absolute rest, and when an extremity is affected, with moderate elevation of the limb. Remedies

to promote absorption of the clot and measures to prevent detachment of the thrombus are essential. Liston's modification of McIntyre's splint (Fig. 1) is a suitable apparatus for these leg cases.. Hot applica-

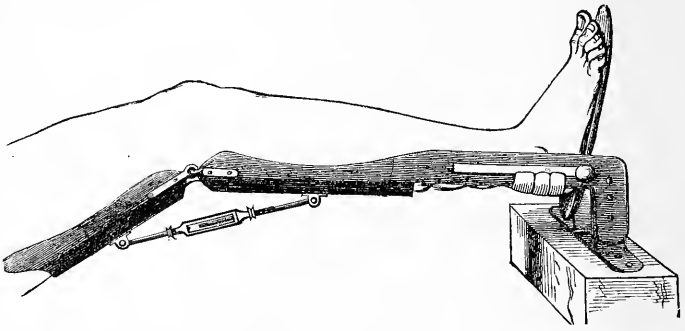

FIG. 1.—LISTON'S MODIFICATION OF MCINTYRE'S SPLINT.—(*Dennis.*)

tions of a saturated solution of boric acid, alcohol, or Thiersch's solution should be constantly applied to the limb and every effort made to promote arterial circulation of the part. "The use of massage, blisters, iodin, and all counterirritants is contraindicated." (Warren.)

Morphin or opium should be given to relieve the pain; nutritious diet and alcoholic stimulants should be given when indicated. If there is total occlusion of the vessels and gangrene occurs, amputation is the only remedy.

Postoperative Gangrene.—Postoperative gangrene from femoral thrombosis following operations upon the abdomen usually makes its appearance about the eighth to the fifteenth day, as before alluded to, but gangrene following amputation of crushed extremities may result from neglecting to amputate sufficiently high above the injured part to secure good circulation. Plate I illustrates this condition following a Teale's amputation of the leg.

Gangrene Produced by Carbolic Acid.—Swain notes that many surgeons have discarded the use of carbolic acid except for the immersion of instruments which are tarnished by solutions of mercury, but that it is not yet sufficiently known that this too popular antiseptic is liable to cause gangrene when applied to the extremities even in dilute solutions. The dilute solutions cause no pain, and are therefore the most dangerous.

Harrington has collected a total of 132 cases of gangrene from dilute

solutions of carbolic acid. It appears from his observations that the damaged condition is due to duration of the application and to the thickness of the patient's epidermis more than to the strength of the solution. Levai is quoted as saying that strong solutions are less dangerous because they form a more or less impervious scab. According to the same observer, the death of the part is due to a direct chemic action on all the tissues. Carbolic acid has no specific quality for producing gangrene, for a like effect is produced by 5 percent solutions of hydrochloric, nitric, sulfuric, acetic acids, and by caustic potash when applied to an extremity by a moistened compress for about twenty-four hours. Tight bandaging undoubtedly increases the tendency to this process, but experiments have shown that the gangrene does not result primarily from this cause.

THE TREATMENT of this condition varies according to severity. If it appears superficial, and the case is seen soon after the removal of the carbolic dressing, it would be beneficial to apply a dressing saturated with alcohol or lime-water, but in other cases it soon becomes evident that amputation is the only recourse. The best prophylactic consists in the avoidance of the use of carbolic acid for wounds, and it is the duty of physicians to show by their example that the public should not make use of this antiseptic.

Postoperative Cystitis.—Postoperative cystitis is usually the result of infection following catheterization, hence the greatest care should be exercised in the sterilization of the instrument and parts adjacent to the external meatus. The parts should be well exposed and cleansed before the introduction of a catheter. Despite the greatest precaution, however, infection sometimes occurs; hence no patient should be catheterized until all other methods have been exhausted.

TREATMENT.—The first and most important consideration in the treatment of cystitis is to discover the cause of the morbid condition. Albuminuria or nephritis the immediate effects of sulfuric ether, lesions of the spinal cord, and constitutional conditions such as gout and lithiasis must not be overlooked.

Local treatment of cystitis consists in the use of irrigations or injections with antiseptic solutions. For this purpose a large variety of drugs is available, including silver nitrate, the newer silver salts, potassium permanganate, boric acid, fluid extract of hydrastis, etc. Irrigation by means of a double catheter should be employed and repeated two or three times a day. One of the best means of flushing the bladder and dimin-

ishing the irritating effect of the urine is to let the patient drink abundantly of pure hot water. If mineral waters are preferred, they should not be carbonated, as this sometimes acts as an irritant. Internally, the balsams, such as copaiba, cubebs, and sandal-wood, are much less frequently prescribed than formerly, and this applies as well to such remedies as buchu, triticum repens, corn-silk, uva ursi, etc. At the present time urotropin enjoys the greatest popularity, its action depending upon the liberation of formaldehyd in the urine, which is thereby prevented from undergoing decomposition, while the pathogenic organisms are either destroyed or inhibited in their growth. The value of urotropin has been fully established by numerous observations, but more recently attention has been called to the fact that in some cases its use is not devoid of injurious consequences; thus, it may give rise to gastric disturbances, diarrhea, hematuria, and strangury. These by-effects may be obviated by giving the drug well diluted, and by reducing the dose in cases in which the urine is very acid, or by giving it in alternate doses with a saturated solution of sodium phosphate. Urotropin sometimes fails to act in cases of ammoniacal fermentation, in which case the urine should be rendered slightly acid or the bladder irrigated frequently, and kept as nearly empty as is possible.

For the treatment of more severe cases of cystitis the reader is referred to articles upon this subject as discussed in text-books.

Postoperative Neurasthenia.—Postoperative neurasthenia is becoming quite common, and is certainly the most annoying and intractable of all postoperative neuropsychoses. It is now an established fact that the injury and shock of surgical operations may be followed by symptoms of well-recognized neuroses or pyschoses, or the symptoms of one or more of these disorders may be blended in the same case. Many of these are mixtures of hysteria and neurasthenia; others may be shown to depend upon the structural changes in the central nervous system of which the clinical manifestations are associated with symptoms of hysteria and neurasthenia. In postoperative neurasthenia the mental state is subject to wide variations. The disorders assume the type of hypochondriasis less frequently than melancholia or dementia.

Hysteria or neurasthenia following surgical operations is not always of the pure type seen when the affection develops in men or women from nontraumatic causes, and whether it is due to the trauma, directly attributable to the operation, the result of fright, or, lastly, the effects of the

anesthetic used, has as yet to be determined. By far the larger number of cases of postoperative hysteria or neurasthenia may be explained on the assumption that the symptoms are those of hysteria or neurasthenia, functional disorders of which the pathology is unknown, the symptoms, as a rule, differing in no essentials from those of organic nervous disease. When the factors are active in the production of postoperative neurasthenic symptoms, an important place is occupied by previous disposition, either hereditary or acquired through excesses. In hysteria and neurasthenia originating from causes other than trauma it often may be discovered that previous to the appearance of symptoms the resisting powers of the nervous system had become enfeebled through various causes. Unfortunately, however, postoperative neurasthenia frequently appears in persons previously healthy and active, and it is often impossible to discover any predisposition thereto. The influence of "suggestion" by sympathizing friends is frequently an important factor in the causation of both postoperative neurasthenia and hysteria. In many cases it seems as though these disorders or their appearance are in a great degree due to the fact that the sufferers have been told by sympathizing friends of the terrible ordeal through which they have passed. Examples of the bad effect of such statements are numerous. The following is a typical case of this character:

Mrs. A. B., aged thirty-four, a very stout and apparently rugged woman of German descent, was the wife of a well-to-do farmer, but had always been accustomed to doing heavy indoor and outdoor work; had borne no children. During the summer of 1900 she complained of occasional abdominal pains and menstruation became somewhat profuse. Upon examination later it was discovered that she was afflicted with a fibroma of the uterus. In March, 1901, myomectomy was performed. The recovery from the operation was rapid and no ill results were apparent. A few months after the operation there supervened a condition of extreme nervousness, irritability, sleeplessness, and despondency. She finally settled upon the conviction that the operation had not been performed in a skilful manner. Her physical condition was perfect, menstruation normal and regular, appetite very good, bowels regular, pulse-rate and temperature normal, and no evidence of organic disease. The skin over the whole body was hypersensitive. The patient finally became bedfast. So persistent was she that something was wrong within the abdominal cavity that an exploratory laparotomy was performed with the hope of at least effecting a mental cure. This operation was performed in June, 1901. Nothing whatever abnormal was discovered,

no adhesions were found, patient recovered from the operation and returned to her home greatly improved, and was able to do her own housework. Later, however, she gradually passed into her former condition. In August, 1902, about fourteen months after the last operation, she was bedfast. An examination failed to find any evidence of organic or nerve injury, there was no contraction of visual field, no paralysis, no disturbance of the functions of the bowels, bladder, or ovaries. The patient was depressed, tremulous, and anxious, skin was hypersensitive, pressure over the vertebras caused expressions of pain. She complained of gaseous distention after eating, and persisted in her refusal to sit up or walk. Evidently a confirmed neurasthenic.

Neurasthenia arises, according to some authors, from a general defect in the nutrition and action of the nervous system, or the result of reflex irritation or degenerative changes in the nerves. It may follow surgical shock or exhaustion of the nervous system. In my experience the severity, character, or extent of the operation has no special determining influence. Functional neuroses often follow minor surgical traumatisms.

Symptoms.—The general characteristics of neurasthenia are so familiar as not to require repetition here. Patients complain of exhaustion, mental irritability, loss of memory, disturbed sleep, headache, palpitation of the heart, dyspeptic trouble, foul breath, constipation, nausea, etc. (Thorburn.) All symptoms tend toward chronicity; many are sensitive or emotional and subject to migratory or neuralgic pains in the abdomen, limbs, or head. There is very frequently no impairment of general nutrition. The absence of organic lesions or disease, and of distinct symptoms denoting the existence of pathologic changes, simplifies the diagnosis. While it is true that many of these cases are complicated by the hope of legal redress, yet they frequently occur independent of "suggestion" or the counsel of friends or lawyers. The symptoms are often complicated by exaggerated or purely imaginary troubles; and the reflexes are usually abnormal.

Nature, Duration, and Severity of Case.—No very important conclusions can be drawn from the nature of the case—that is, whether it is of a hysteric or neurasthenic character—as regards the prognosis. (Warren.) The duration of symptoms is indefinite, owing to the tendency to the formation of "associated" neuroses. Many of these patients become chronic hypochondriacs, yet because of the fact that the symptoms as a whole are often the result of delusion, efforts should be made to relieve their pitiable condition, and the patient should have

the benefit of thorough expert treatment. The features that make the prospect of recovery unfavorable are neurotic temperament, lack of firmness or a natural tendency to nervous depression, and loss of will-power, energy, or desire for recovery. Many assume a form of lethargy or morbid inaction, from which nothing arouses them, and they remain thus for years. True neurasthenia is an obstinate and tedious affection; the hysteric form is less serious.

Diagnosis.—"The physician, in approaching a case assumed to be one of the posttraumatic neuroses, is obliged to consider, first, whether the patient is simulating or is really ill; next, the type of the illness, if it exists; and, further, to what extent it may be considered as superficial and under the domination of excitement and the events of the operation or, on the other hand, due wholly or in part to actual lesions of the nervous system or to profound disorders of circulation and nutrition. It is his duty to determine how far it may be attributed to the action of previously existing neuropathic tendencies, or contributive degeneracies of other origin, or to other causes not connected with the operation." (Warren and Gould, "International System of Surgery.") As regards the commoner types of disease (hysteria, neurasthenia, the psychoses, the spinal scleroses, the cerebral and spinal degenerations of vascular origin, strain of the lumbar muscles, spondylitis secondary to injury of the vertebras, etc.), while the diagnosis in well-marked cases is easy, there are certain essential considerations to be borne in mind. The chief of these, according to Bailey, are the following: It is important to distinguish between true neurasthenia and hysteric neurasthenia, the former being a more severe affection than the latter. The psychoses may, on the same principle, have a hysteroid element in them, the spinal scleroses and subacute myelitis may be simulated by hysteria or hysteroid affection, though a judicial consideration of the whole case will generally make the diagnosis possible. Finally, it is important to note that hysteria may coexist with organic affections, so that the physician must be prepared to diagnose both conditions separately.

Treatment.—Enforced rest, as suggested by S. Weir Mitchell, absolute isolation from friends and relatives, cauterization of the back of the neck, as recommended by Shoemaker, correction of the digestive functions, chalybeates and tonics as required, and, lastly, static electricity, complete the list of methods of treatment suggested by the best authorities for the relief of this condition.

Postoperative Insanity.—Postoperative insanity, like other postoperative neuroses, bears no definite relation to the character or extent of the operation performed, and is of itself a comparatively rare occurrence. The majority of the cases reported can be attributed to the effects of the anesthetic and most frequently occur among patients predisposed to attacks of insanity; or they may be due to acute sepsis or metastatic cerebral abscess resulting from operation, in which case we have a rise of temperature and other acute symptoms denoting infection. These cases, although presenting symptoms of acute mania, should not be classed as postoperative insanity. The true type of postoperative insanity may be justly attributed to morbid brooding, fright, or mental anxiety over the operation, or from the previously diseased condition calling for operative interference, and not to the operation *per se*. Operations upon neurotic individuals or persons of high-strung nervous temperament are frequently followed by hysteria or neurasthenia, as heretofore described. Picque and Brand ("Med. Bulletin") have published an important paper upon mental disturbances or psychoses following surgical operations. Under the term "postoperative psychoses" they include only delusions with or without mental confusion, and affecting the intellectual functions only. Neurasthenia, hysteria, or hypochondriac characters or other neuroses are not included in the category of postoperative psychoses. All forms of cerebral excitement or delirium which persist after the operation, and which may be attributed to an undue sensitiveness of the patient to the anesthetic, are stigmatized as "toxic pseudodelirium," which is of transient character, lasting, as a rule, but a few days. True postoperative psychoses are serious forms of mental disturbance which require care and treatment in an institution.

Symptoms.—The symptoms of postoperative insanity are variable. They comprise maniacal excitement, delusions of persecution, and melancholic depression, accompanied frequently with suicidal tendencies.

Treatment.—When there is the slightest indication of insanity, the patient should always be under the charge of a constant attendant. Rest, careful attention to general nutrition and hygiene, isolation from friends, with judicious employment of nerve tonics, valerian, and hyoscyamus, with hypnotics and general tonics as indicated.

Postoperative delirium frequently results from prolonged fasting and exhaustion of the nerve-centers incident thereto. This is often

noticeable after operations upon the stomach and intestinal tract, in which, from long-continued suffering and fluid diet, the patient finally loses his mental equipoise, and symptoms of mania or melancholia agitans supervene with little or no warning.

The personal experience of the author warrants him in emphasizing the statement that it not infrequently happens in these enfeebled patients that the long-continued use of iodoform, powder or gauze drainage, increases the tendency to delirium, or may possibly be the exciting cause thereof. An examination of the urine should therefore be made, and if iodin is found, other forms of antiseptic or aseptic dressings should be substituted.

The prognosis in this form of delirium is usually favorable, but the period of convalescence may be greatly protracted.

Postoperative Jaundice.—R. DeBovis reports two cases of jaundice following surgical and obstetric operations. The first was in a young man upon whom he operated for a small inguinal hernia. Chloroform was used as an anesthetic and the operation lasted about half an hour. Healing occurred by first intention. On the second day jaundice appeared, which by the third day had increased in intensity. The urine was characteristic of this condition. The temperature and pulse were normal. Toward the sixth day the jaundice began to disappear rapidly. The second case was that of a woman in whom there was rigidity of the os uteri during labor, due to thickening and cicatrization from previous labors. In order to facilitate delivery, the tissues were incised under anesthesia. Three days later jaundice appeared, and was accompanied by a slight elevation of temperature. It diminished gradually, and when she was discharged, twelve days later, it had entirely disappeared. Similar cases have been reported by various writers. De Bovis believes that, aside from jaundice due to operations upon the gall-ducts, which is of grave prognosis, there is a form of jaundice following operations which is benign in character and of short duration, due to simple biliary retention by reflex action. The author has seen several cases of postoperative jaundice occurring from the third to the sixth day. The attacks are usually of a mild type and subside without special medical treatment in from eight to ten days.

Mayo Robson has recently drawn attention to the value of calcium chlorid in the treatment of patients suffering from jaundice at the time of operation. He administers the drug by the rectum in doses of 60 grains, thrice daily, until all signs of oozing from the

wound have ceased. It is better, however, to use this drug as a prophylactic agent, beginning administration two or three days prior to operation. It is claimed that if administered for longer than three or four days, in large doses, it actually diminishes the coagulability of the blood. Ruspini's styptic (Liquor ferri perchloridi with an equal part of tincture of matico) is recommended by English writers, and is best applied by soaking narrow pieces of lint and then carefully packing the wound and applying pressure over it.

Postoperative Erysipelas.—This is a form of infection characterized by an acute inflammation of the skin and deeper structures, accompanied with fever and general constitutional disturbance. The affected area is usually well defined, the skin assuming a red or crimson color, or may appear of a slightly purple color and shine or glisten from edema of the parts. The skin becomes hot and tender to the touch and blebs or vesicles later make their appearance. The affection is due to the introduction of *Streptococcus erysipelatis*. The cocci may enter directly through the wound and from this point spread rapidly through the lymphatics or capillaries to the surrounding tissues, or if the patient happens to be afflicted with a local form of erysipelas at the time of the operation, the operative wound, though at a distance, may later become infected by the cocci being carried through the circulatory system.

The following case seems to warrant the belief that the virus may be transmitted through the circulation:

G. S., aged thirty-one, farm-hand, was suffering from an acute attack of facial erysipelas to which he was frequently subject. In going to his home in an adjacent county he unfortunately had his right foot crushed in attempting to board a moving freight train, necessitating the amputation of the toes and a part of the foot. Every precaution possible was taken at the time of the operation to prevent infection of the operative wound, but on the fifth day erysipelas of a phlegmonous character developed in the wound, requiring numerous incisions and constant irrigation. The patient was confined to his bed several weeks, but ultimately made a good recovery.

As to whether or not erysipelas is communicable or contagious is still a much argued question; the majority of surgeons favor the idea, and the abundance of clinical proof offered appears to warrant the belief that the disease is, at least in some of its forms, communicable. In these days of aseptic surgery it may be possible for a patient with erysipelas to remain in a surgical ward without contaminating others, but there are

cases of such virulence, especially of the phlegmonous type, which should, in my opinion, be promptly isolated and the strictest measures taken to prevent possible contagion. I believe isolation to be the safest and most rational course to pursue, even in the mildest of cases, and I would be unwilling to permit a patient afflicted with any form of erysipelas to enter my surgical ward.

Symptoms.—The disease may appear any time during the healing of the wound, but usually commences from four to seven days following the operation. There are, as a rule, certain premonitory symptoms preceding the actual attack, such as malaise, headache, loss of appetite, and a feeling of tension and pain about the wound. In other cases the disease may begin suddenly with a severe rigor, without any premonitory symptoms. However the attack may be ushered in, it is followed by a rapid rise in temperature to about 104° F. Along with the rise in temperature there is headache, probably nausea and vomiting, a rapid, soft pulse, foul tongue, great thirst, scanty urine, diminution of the discharge from the wound, and swelling of the neighboring lymphatic glands, to which latter there may be red lines running from the wound. Occasionally there is acute delirium. In from ten to twenty-four hours after the rigor a red or crimson blush, sharply marked off from the surrounding parts, appears around the wound, and the reddened portion is somewhat swollen. The redness increases and usually spreads along the course of the lymphatic vessels, that is to say, toward the trunk. The margin of the inflammation can be felt as a distinctly elevated ridge. Where the tissues are lax, as in the eyelids or the scrotum, the swelling may be very great, and bullas may form upon the surface. Bullas may also appear, although not so frequently, when the trunk or limbs are affected. During the course of the disease there is often albuminuria. After six or eight days there is generally a rapid fall of the temperature, which has remained high during the acute period. The constitutional symptoms disappear, the appetite improves, the redness gradually fades and usually disappears by the middle of the second week; finally, desquamation occurs. This desquamation is of great importance because it is in the scales of epidermis that the chief source of the erysipelas infection is to be found. In severe cases the disease may end fatally, during the second week, from pyrexia and general exhaustion. The most serious form of erysipelas is described as phlegmonous or gangrenous. In such cases, along with the symptoms already described, there is suppuration into the subcutaneous tissues, which sometimes takes

the form of an abscess, but more commonly manifests itself by a diffuse cellulitis; occasionally the skin sloughs together with the deeper tissues. In these cases the patient usually soon passes into a typhoid state and death frequently occurs.

Treatment.—The treatment of erysipelas is both constitutional and local. The internal treatment should be supportive; antipyretics and purgatives and other depleting remedies should be avoided, since the system requires strength to combat the sepsis. Mild and agreeable tonics with proper nourishment are usually all that is necessary. The much extolled remedy, tincture of the chlorid of iron, as recommended by Hamilton Bell and other English writers, has proved of very little value except in chronic cases, and has now been abandoned by many surgeons. In case the infection is pronounced and the temperature rises to 103°, 104°, or 105° F., antistreptococcic serum frequently proves of marked benefit, and should always be used in severe cases. In the aged and feeble or in those broken down by wasting diseases alcoholic stimulants are of value if used judiciously. To control delirium the bromids, chloral, or hyoscin may be employed with safety, and, lastly, a mild aperient, such as effervescent sodium sulfate in dram doses, should be given as required.

Local Treatment.—Lotions and ointments innumerable have been recommended. In the rapidly spreading forms of erysipelas strenuous efforts should be made to check the progress of the disease. The old method of drawing a line on the skin around and above the area of redness, with silver nitrate, or painting the skin in a similar manner with iodin or creasote, may still be used with good results if employed early.

Kraske's method of making numerous small scarifications in the skin around and above the seat of infection acts on the same principle, but likewise must be employed early if benefit is to be expected. Later, injections of a 2 percent solution of carbolic acid, as recommended by F. P. Henry, although at times painful, often yield excellent results. The injections should not be made into, but a little beyond, the border of the inflamed parts. The needle of the syringe should be pushed in various directions under the epidermis in order to disseminate the fluid as extensively as possible. Injections may be repeated once daily and gradually increased to twice or three times a day, using about one fluidram of the solution at each insertion. Solutions of salicylic acid, 5 to 10 percent, and sodium sulfocarbolate, 20 percent, have also been used subcutaneously with advantage.

Topical Applications.—Of the numerous topical applications recommended, a solution of creolin, one-half to one dram in a pint of sterile water, appears to have proved the most beneficial. It is nontoxic and may be applied over large surfaces. Lint kept constantly moist with the old-fashioned lead and opium wash is frequently very soothing and tends to allay the itching and burning of the inflamed wound or skin. Later, when desquamation is noticed, ointments or oleates act better. Ichthyol ointment, 10 percent, eucalyptol ointment, zinc oxid ointment, castor oil, or plain cosmolin will not only tend to allay irritation, but lessen the chance of dissemination of the infective desquamating epithelium.

Treatment of the Phlegmonous Types.—The graver forms of phlegmonous or gangrenous erysipelas, or malignant edema, must be dealt with promptly and heroically by long and deep incisions. Many lives have been saved by the prompt interference of the surgeon. Warren states that free incisions allow the escape of the pent-up discharges, and free drainage prevents the invasion of bacteria and their products into the lymphatic system, hence free drainage is the prime factor in the successful treatment of these cases, after which constant irrigation should be carried out in the manner described under the treatment of septic wounds.

Postoperative Peritonitis.—The treatment of postoperative peritonitis varies greatly; the cause of this variance being possibly the vast difference in the type and severity of the infection. A small localized collection of pus in the abdominal cavity often becomes safely walled off in a few hours, while, on the other hand, the infection of the central portion of the abdominal cavity is inevitably fatal unless prompt surgical interference is adopted.

Before entering upon the subject of operative treatment, which is called for in a large majority of the cases, it may be well to indicate the scope and limits of purely medical means. If the diagnosis has been made early and the condition is mild or localized, divided doses of calomel, followed by a brisk saline purge, may serve to remove some of the fermenting contents of the bowels and assist in the removal of the toxins from the peritoneal cavity. But it must always be borne in mind that the formation of adhesions or the possibility of perforations is an absolute contraindication to the use of any laxative, so that the use of such treatment has come to be limited to postoperative cases. *Local measures*—application of cloths saturated with alcohol, applied as hot as possible

poultices, stupes, ice-coils, and the like—serve chiefly to make the patient more comfortable, and probably influence very little the actual course of the disease. ("Text-book of International Surgery.")

Believing that the presence of fluid in the peritoneal cavity favors extension of the disease, and that the pelvic peritoneum, from its lessened capacity for absorption, is better able to combat infection, Fowler (Brooklyn) ("New York Medical Record") has treated patients by elevating the head of the bed in order to facilitate the passage of septic fluids from the general peritoneal cavity to that of the pelvis, where they would do less harm and be more readily removed by drainage methods. He insists that the elevation of the head of the bed shall exceed the foot by at least 12 to 15 inches. A large pillow is placed beneath the knees and the buttocks are allowed to rest against this to prevent the body sliding down. The pillow is made fast by a bandage to the sides of the bed. A number of patients were treated by this method with satisfactory results.

Should operative measures be decided upon, shock is to be avoided by the use of an anesthetic, and ether is perhaps the best for its stimulant effect upon cardiac muscle already weakened by the action of the absorbed toxins. To aid the general anesthesia and to diminish the amount of ether necessary to prevent any movement on the part of the patient,—for that is all that is required,—a moderate preliminary dose of morphin hypodermatically is valuable. Its effects are also desirable after the operation in quieting the patient and diminishing peristalsis, and it in no way interferes with subsequent treatment by means of laxatives. In extreme cases it is best to employ cocain, or cocain combined with morphin, for purposes of anesthesia, because any general anesthetic would inevitably be fatal. A very thorough cleansing operation is almost impossible under cocain, yet enough can be done by abundant irrigation and subsequent drainage to give the patient his best chance for life.

One procedure which should never be omitted previous to operation upon patients in whom there has been fecal vomiting, or even a tendency to intestinal paresis and gaseous distention, is a thorough lavage of the stomach. This simple procedure obviates many of the dangers of a general anesthetic. There can be no infection of the air-passages, with subsequent septic pneumonia, because the patient does not regurgitate the foul contents of his stomach and upper bowel. There is less likelihood, also, of persistent vomiting after the operation, and the patient gains a period of relief and quiet.

The choice of an incision depends largely upon the condition one expects to find. If the infection follows an appendicectomy or the breaking of an abscess into the peritoneal cavity, and if the symptoms do not point to a general invasion of the whole peritoneum, the opening should be made with a view to giving the best possible exposure of the field to which the trouble may be confined. On the other hand, if the patient's condition shows that the infection has become a generalized one, the incision should be made in the median line, and long enough to give free access to all parts of the abdominal cavity. There are then two methods of procedure: (1) Careful mopping up of all exudate from the cavity and the loops of the gut, and (2) free irrigation with hot normal salt solution. The choice depends on the condition found. If the process is spreading, but does not as yet involve the whole of the peritoneum, it is improper to irrigate and thus spread the infection to tissues still intact. The rarity of a universal peritonitis is seldom appreciated. What usually passes for this condition is a fairly well localized inflammation without any limiting adhesions. In such conditions it is wiser carefully to sponge out all the visible exudate with pads of sterile gauze which have been wrung out of hot normal salt solution. A certain amount of traumatic injury is necessarily inflicted, but this is far more easily cared for by nature than the additional toxemia which would inevitably follow irrigation. This cleansing process should never extend beyond the visible limits of the disease; the remainder of the abdominal cavity is to be protected carefully by large, dry, sterilized gauze pads passed between the intestines and the abdominal wall, to be left until all the cleansing process is over. The removal of these pads from the abdomen is much facilitated by having a long tape firmly stitched to one corner; this also relieves the operator from the embarrassment and doubt of having left a pad in the abdomen. When the infection is undoubtedly general, the patient's life should not be risked by any prolonged search for the site of the perforation, but an ample median incision is to be made, and the whole peritoneal cavity thoroughly flushed with salt solution of a temperature of at least 105° F., or even higher, for it is well to remember that the temperature of the blood in these patients is often over 107° F., and to obtain any stimulant effect from the heat the solution should be several degrees higher. A temperature of the salt solution as hot as the hand can comfortably bear represents from 107° to 110° F. When the water returns clear from all portions of the abdomen, it has accomplished all that is possible; but none of the de-

pendent portions of the peritoneal cavity must be forgotten. Special attention should be paid to the pelvis, the suprahepatic spaces and those outside the colon. A long tube should be carefully passed to each of these spaces to obtain the full cleansing effect of the stream. All easily loosened masses of fibrin and pus should be gently sponged off the surfaces of the viscera, and so much as possible of the fluid still in the abdomen should be absorbed by gauze pads. It is well to make two counteropenings, one in either flank, through which drainage can be made, and any accumulations in the depressions outside the colon thus removed. The choice of the drainage material lies between gauze and rubber tubes. Most operators at the present time incline to the use of gauze; some prefer to combine the two, using gauze wicks about the tube, but retaining the latter because of the ease by which the discharges can be removed by occasional irrigations without disturbing the dressings to any extent. In any case the material used must be capable of carrying off large quantities of fluid for the first forty-eight hours, as the absorptive power of the peritoneum is so reduced by inflammation and the traumatism of the sponging and irrigation that it is utterly incapable of taking care of the fluid secreted.

Recently the suggestion has been made to remove the intestines from the abdominal cavity and forcibly scrub them with gauze pads wrung out of hot salt solution. During the process a continuous stream of the same fluid is to be kept flowing over the exposed loops, to prevent chilling and to wash away the loosened masses of fibrin and pus. Such a method is certainly not applicable in case of great septic absorption, and in which the diminished strength of the patient often could not survive the anesthetic. Its field, if any, is more in those cases of fairly well-localized peritonitis of a low grade of virulence and a tendency to produce large quantities of fibrin without much general toxemia, and even in these it is unnecessary, and, therefore, to be condemned. Another method, which has as yet been little used, is a continuous bath. This plan of placing the patient in a bath of sterilized salt solution at 98° F., after opening the abdominal cavity, is indeed a heroic measure, but the results of its use in cases of suppurating joints and other severe infections would certainly warrant its trial in desperate conditions. It permits the free escape of pus lying between the coils of the intestines, and with the least traumatism. Experimentally it has been found that the peritoneum of animals would perfectly well endure an exposure of two hours in a warm normal salt bath without serious change in the lining en-

dothelium. In man, however, no very remarkable results have been reported, probably because it has only been tried on moribund patients.

The suture of the incisions is rarely advisable; it takes time and prolongs the anesthesia. The sides of the wound can be easily held together by the dressings. In cases in which the distention of the intestines is so great that difficulty is experienced in returning them to the abdominal cavity, it is an excellent plan to puncture several of the most distended loops after their removal from the proximity of the incision, and thus permit the escape of gaseous and fluid contents. A quick and perfect method of accomplishing this is by making a purse-string suture of three stitches at the point selected, between which a good-sized aspirator-needle pierces the bowel, relieving gas and liquid contents without contaminating the neighboring parts. Before closing the puncture excellent results have been obtained by injecting into the lumen of the gut several ounces of saturated solution of epsom salts. This promotes peristalsis, cannot be vomited, and thus carries off the poisonous contents of the bowels. An enema of eight ounces of hot, black coffee with an ounce of whisky should follow the operation.

The above measures are recommended and adopted by many of the very best surgeons, and constitute an epitome of their latest writings upon the subject. The plan, however, suggested by E. W. Dwight ("Medical and Surgical Reports, Boston City Hospital"), can be accomplished in much less time and has proved, in the few cases in which we have employed it, to be equally effective, and preferable to the more formidable measures. The method is as follows: An incision is made as directly over the source of infection as possible—a one-and-one-half to two-inch incision is sufficient for this purpose. If the purulent fluid is found free in the abdominal cavity, no attempt is made to discover its source. Through the incision a large glass tube, one inch in diameter and twelve inches long, is introduced. Through this is poured a large quantity of normal salt solution as hot as can be borne with comfort on the back of the hand. Flushing is kept up until the fluid returns from all portions of the peritoneal cavity quite clear. The tube is then removed, the excess of fluid permitted to escape, and three or four gauze drains are placed in different directions in the abdomen. A very large quantity of salt solution is used—20 to 25 two-quart bottles in a single operation. If this method is carried out accurately, it is believed that the toxic dose is reduced to the minimum with the least traumatism to the peritoneum.

The after-treatment must be sharply stimulating; strychnin hypodermatically, in doses of $\frac{1}{40}$ to $\frac{1}{20}$ grain, can often be given every two hours with great advantage; a little morphin may be given advantageously if required for pain or restlessness. The great advantage of the morphin is that it allows the patient to breathe with more freedom, because of the fact that such movement no longer causes pain, and thus permits the free motion of the diaphragm. This is known to be one of the most potent factors, physiologically, in promoting the flow of lymph, and hence in absorbing fluids from the peritoneal cavity. An ice-coil to the abdominal wall is often exceedingly grateful to the patient, and no doubt relieves to a certain extent the congestion and inflammation of the diseased peritoneum. Nourishment is advised within twelve hours in amounts as large as the patient can bear. If vomiting continues, rectal feeding is substituted. Should small localized abscesses subsequently develop in different parts of the peritoneal cavity, anesthesia should then be induced and the abscess cavities emptied.

Summary.—There are certain matters in connection with the treatment of postoperative peritonitis which must be constantly borne in mind. There are relative indications. There are complications that demand intervention. There are conditions where, in the author's judgment, an operation offers the only chance, and where the patient will surely die unless saved by surgical procedures. Death may occur in any event. It must occur under certain conditions unless prompt relief is afforded.

The first matter of importance in this connection is that the bowels must act regularly—that is, that they should be open. With severe abdominal pain, nausea and vomiting, excessive tympanites, the ingestion of but a small quantity of nourishment, which is often exhibited in concentrated form, it is not reasonable to suppose that there shall be a free fecal discharge every day, but at the same time any indication of obstruction must occasion serious anxiety. With the bowels inflamed we should understand just what may happen. The tympanites and tenderness may prevent our recognizing a volvulus, an intussusception, or an obstruction caused by adhesions. The surgeon must not wait for stercoraceous vomiting: he must be prepared to act so soon as there is evidence of obstruction.

To assert just what symptoms will warrant an operation is a very difficult matter. If the treatment of peritoneal infection begins by giving salines, calomel, enemas of glycerin and water, or concentrated

solutions of magnesium sulfate, we usually succeed in evacuating the bowels. If we fail, it may be necessary to flush the colon. If these measures are unavailing and if there is nausea and vomiting, an exploratory incision is indicated, especially if there is excessive tympanites which prevents the palpation of any abdominal tumor that might be caused by some form of obstruction or adhesion. The possibilities of a spontaneous recovery when peritonitis exists are problematic in the extreme. Excessive tympanites is seldom *per se* an indication for surgical interference. It persists after all other symptoms have subsided, sometimes causing much inconvenience.

As a matter of fact, the whole subject of operative relief for peritonitis may be summed up in very few words. If pus is present, it must be evacuated; if adhesions cause obstruction, or if conditions prevail that make it probable that their formation, or the formation of pus, will jeopardize the patient's life, we must operate, and it is well to do so without delay. Other conditions admit of a difference of opinion, and the existing circumstances will determine our plan of action. The conditions I have mentioned admit of no controversy. Consistent and courageous surgical aid is the only thing to be thought of.

Postoperative Bedsores.—Bedsores, a form of gangrene, are the result of continued pressure, and it is very important to remember this when a patient has to be kept in one position for a long time. Under such circumstances, the parts subjected to pressure are very apt to die, and this is more especially the case with soft parts over long prominences, such as the sacrum, or those subjected to pressure against the edge of a splint. The gangrene in these cases is moist.

THE TREATMENT of bedsores resolves itself into: (*a*) prophylaxis, (*b*) treatment when a bedsore is threatened, and (*c*) when it is actually present.

(*a*) *Prophylaxis.*—The essential points in the prophylactic treatment are, in the first place, to avoid continuous pressure, or so to vary or diffuse it that it shall not exert itself too long or too injuriously on one part; and, in the second place, to keep the skin dry. The first indication is carried out by frequently altering the position of the patient or the part, or by so arranging matters that the pressure shall not be brought to bear on a bony prominence. For instance, the patient may lie on a ring-pillow, the opening in the pillow being opposite the part where pressure is to be avoided. Or he may lie upon a soft wool pelt, tanned with wool intact.

Another and in most cases the best plan is to place the patient on a water-pillow or water-bed, so that the pressure does not remain localized to any one point, but is distributed over a wide area. In using a water-pillow care must be taken that the proper quantity of water is introduced; if too much is present, the pillow becomes hard and convex, and does not adjust itself equably to the skin. On the other hand, if there is too little water, the patient is not properly supported, and the part comes in contact with the bed. Just sufficient water should be put in to keep the patient floating, and a good method of testing this is to bear one's whole weight on the pillow by pressing the two spread-out hands in the center; if they just touch the other side of the water-pillow, the patient's body will float when laid upon it. The water in the pillow should be tepid when introduced and it ought to be changed every three or four days, otherwise it is apt to become foul. A large water-pillow must, of course, be filled upon the bed. The pillow is covered by a draw-sheet, and great care should be taken that this is quite smooth.

A second point in avoiding bedsores is to see that the parts most exposed to pressure are kept dry. The patient should be turned over twice a day, and the sacrum, or any other region subjected to pressure, should be carefully washed and thoroughly dried; and not only dried, but rubbed gently with a soft towel so as to improve the circulation and nutrition of the tissues. It is then dusted over with powdered boric acid or talcum powder.

(*b*) *When a bedsore is threatening*, that is, when the skin is becoming red, the same measures should be continued, but it is well to relieve the pressure entirely by placing a ring-pillow around the part on the surface of the water-bed. In addition to gently rubbing the part with a soft towel, the circulation should be further promoted and the epidermis hardened by the application of some stimulating fluid, such as spirits of wine or whisky. The spirits of wine is allowed to dry on the skin, which is then rubbed, and subsequently dusted with powdered boric acid. At a later period, when the skin is becoming raw, lint spread with equal parts of balsam of Peru and resin ointment is a very good application. It should be renewed night and morning, after the part has been washed, dried, and rubbed with alcohol.

(*c*) *When a bedsore has formed*, the slough, and subsequently the sore, must be kept as nearly aseptic as possible. If the patient is lying on the part, it is impossible to carry out one of the chief principles in the

treatment of gangrene, viz., to favor the drying of the slough; and that being so, there is no objection to the use of antiseptic ointments, which is, after all, one of the most valuable methods of keeping the affected area aseptic. The best is the full-strength boric or eucalyptus ointment, changed, when the slough has separated, for the quarter-strength boric. Balsam of Peru, either alone or mixed with white of egg in equal proportions, is also a good dressing. So soon as possible the patient should be made to lie on the side, when the sore will usually begin to heal. Meanwhile the general nutrition of the patient should be attended to by the administration of light and easily digested food and stimulants.

CHAPTER IV.

GENERAL PRINCIPLES OF AFTER-TREATMENT AND POSTANESTHETIC COMPLICATIONS.

CHAPTER IV.

GENERAL PRINCIPLES OF AFTER-TREATMENT AND POSTANESTHETIC COMPLICATIONS.

GENERAL REMARKS.

It would be impossible to formulate a definite set of rules to cover the postoperative management in major and minor operations. Much necessarily is left to the judgment of the attending surgeon and nurse. Some patients are very susceptible to pain; others bear pain surprisingly well. Many are extremely restless, nervous, or hysterical; others calm, stoical, and indifferent. Again, some patients are pleasant, considerate, and easily cared for; others exacting, irritable, and very difficult to control. Tact and gentleness as well as firmness are required for the proper management of these various temperaments, and it should always be borne in mind that patients are entitled to every possible comfort or assistance, so long as it does not interfere with their recovery.

Immediately after major operations, and in minor cases in which there is evidence of shock or exhaustion, and before the patient is removed from the operating table, a high rectal enema of normal salt solution at a temperature of 110° F. should be given, and, if necessary, a hypodermatic injection of strychnin, $\frac{1}{40}$ to $\frac{1}{30}$ grain, should be administered and the patient carefully and gently placed in bed. The patient should then be surrounded with warm-water bottles. But the danger of burns from too close contact with hot-water bottles has not been exaggerated; they should never be placed next the patient, but wrapped in flannel cloths or placed outside of the blankets. The patient must never be left alone. A reliable nurse or attendant should remain with him to guard against accidents from vomiting or choking or prevent any act of violence on his part if delirious, and especially to note any evidence of sudden collapse which may call for immediate measures of relief. It is also important that the anesthetist should remain with the patient until he has recovered from the immediate effects of the anesthetic.

It is our custom, unless specially contraindicated, to place the patient upon the right side (Fig. 4). This position is also strongly recommended by Hewitt in the following language: "In this position stertor at once ceases; the tongue gravitates to the sides of the mouth, and a free airway is established; mucus and saliva are not swallowed; coughing is prevented, and should vomiting occur, any vomited matter will readily find an escape without interfering with breathing."

No nourishment whatever should be given by the mouth for a few hours following anesthesia. To relieve extreme thirst, the frequent sipping of hot water or tea is often very grateful to the patient, and may assist in causing free emesis, which sometimes tends to relieve the feeling of nausea; when this does not suffice to allay the thirst, the holding in the mouth of a cloth or a gauze sponge dipped in cold water and changed frequently may afford great relief.

Pallor and feebleness of pulse which follow anesthesia are usually associated with nausea and vomiting. They may, however, indicate approaching shock, the result of prolonged anesthesia or cardiac failure. The head must be kept low and the patient warm, and quiet, free respiration maintained; enemas of brandy or turpentine with hot water should be given, and, in critical cases, artificial respiration is required, with the hypodermatic use of sulfuric ether, 10 to 30 minims, strychnin, $\frac{1}{30}$ grain, digitalin, $\frac{1}{50}$ grain, and brandy, or, lastly, adrenalin solution. In one instance where there was great cardiac depression, the result of chloroform narcosis, prompt and complete recovery resulted from the use of adrenalin chlorid (1:1000) in 1 ounce of warm normal salt solution administered hypodermatically.

POSTOPERATIVE POSTURE OF THE PATIENT.

General Considerations.—Much has of late been written upon the important subject of posture or position of the patient immediately following operations. Rest, bodily and mentally, is the first consideration. The patient, being placed in a bed previously warmed, should be rendered as comfortable as possible. It seems to be a custom or fancy, among American surgeons especially, that after all operations of severity the patients must be placed in the dorsal or recumbent position, in which uncomfortable posture they are forced to remain, not being allowed to move or turn upon either side for several days.

Allingham, of England, and Fowler, of New York, appear to have

been the first to abolish this ancient custom. Very few people indeed sleep wholly upon the back, and when forced to do so, are exceedingly uncomfortable. There are many rational objections to this position. Women who are kept long in this posture after laparotomy are very liable to develop cystitis from inability to empty the bladder completely. It has been our custom for many years to place patients upon the right side so soon as placed in bed and before they recover from anesthesia. This posture (see Fig. 4) tends to prevent mucus or saliva from collecting in the mouth and fauces, and thus decreases the tendency to nausea and vomiting. Later, if proper abdominal bandages have been applied, we allow the patient, with the assistance of the nurse, gently to assume whatever position is most comfortable. Owing to the prominence of the sacrum and spinal vertebras, the dorsal position, if long continued, is especially apt to cause bedsores, which is not the least objectionable feature. The tendency also to meteorism or gaseous distention of the abdomen is increased by the dorsal position.

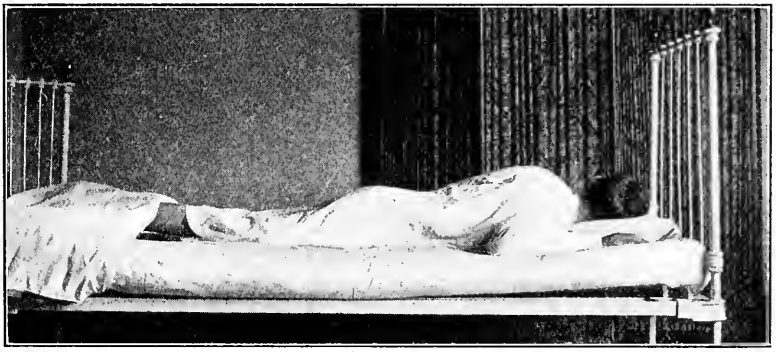

FIG. 2.—PRONE POSITION AS RECOMMENDED BY ALLINGHAM.

Prone Position.—Allingham, of England, has pointed out the value of this position after extensive injury to the extremities or larger arteries. Under such circumstances the integrity of the limb depends upon the rapid development of collateral circulation. When it is desired to drain a wound opening upon the anterior surface of the body, in abscess of the appendix, suprapubic cystotomy, etc., the prone position is far more desirable and the patient finds it more comfortable than the dorsal position.

Fowler's Semi-erect Position (Fig. 3).—This position, so ably recommended by Fowler, is applicable especially to cases of appendicu-

lar abscess, operations upon the stomach or thorax, septic peritonitis, and laparotomies in general, particularly when the patient has been exposed to abdominal infection. In this position all fluids within the abdominal cavity gravitate to the lowest portion, thus limiting the area of possible

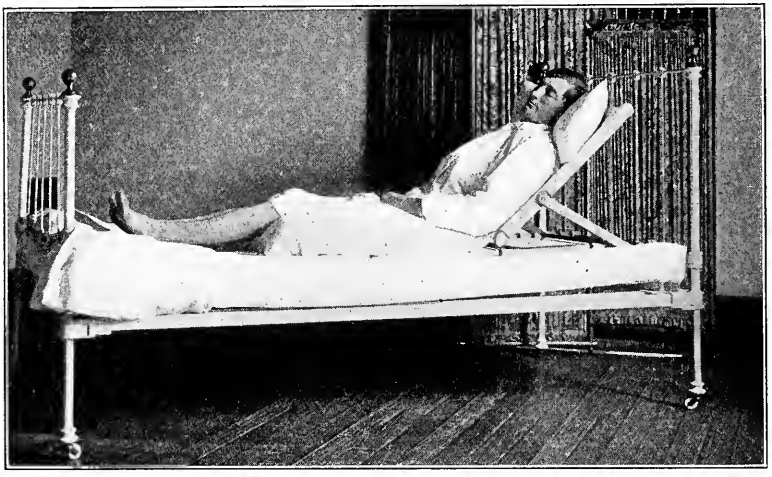

FIG. 3.—FOWLER'S SEMI-ERECT POSITION.

infection and increasing the resisting powers of the peritoneum. This position is far more comfortable than the dorsal posture, and admits of greater freedom in breathing, use of the arms, etc.

FIG. 4.—RIGHT LATERAL POSITION.

The Lateral Position (Fig. 4).—The patient lies upon the side, the knees flexed, with a small pillow or pad between them, and a pillow to support the back. This position is considered by many to be the most comfortable possible. The muscles of the abdomen are relaxed, relieving all tension upon the wound or stitches. Patients in this position urinate more readily and require less attention. Old people and

children should be allowed greater freedom after operation, and if the dressings are fixed with broad adhesive straps, no unnecessary restraints need be insisted upon, except, possibly, enforced quietude.

POSTOPERATIVE NAUSEA AND VOMITING.

General Considerations.—The condition of the stomach prior to anesthesia, the kind of anesthetic employed, duration of administration, character or extent of operation, as well as temperament of the patient, all have their influence upon postoperative nausea and vomiting. If the patient has not been properly prepared, and there is solid or liquid food remaining in the stomach, vomiting will usually be troublesome. Thorough lavage is the best means by which it may be alleviated. As regards chloroform, sulfuric ether, and A. C. E., and other mixtures, authorities agree that the administration of ether is more often followed by transient retchings, but severe, protracted, and dangerous vomiting is more common after chloroform. "Vomiting after A. C. E. mixture is usually slight, though sometimes protracted. Old people are rarely affected by after-sickness from A. C. E., even though the administration has been prolonged. Billroth's mixture of chloroform and ether has been received with great favor by continental surgeons, and is said to be rarely followed by vomiting." (Hewitt.)

In all forms of anesthesia one of the principal objections is the fact that the operator is led to ignore the flight of time, to the detriment of the patient. It should always be remembered that the shorter the operation and the smaller the amount of anesthetic given, the better. The patient once having been anesthetized, the rule to be borne in mind is the saving of time, animal heat, and the amount of anesthetic. Some patients are more prone to vomit after anesthesia than others. According to Hewitt, rosy-cheeked children, young women of good color and full lips, and flabby-looking individuals with an unhealthy and dusky appearance are much more liable to postoperative vomiting than others. Such patients nearly always secrete large quantities of mucus and saliva. Thin, spare, and sallow patients, those who have become anemic from exhausting diseases, and aged persons are not often nauseated after anesthesia. Patients of "bilious" habit frequently suffer a good deal after ether or chloroform.

Lastly, the nature or extent of the operation has its influence upon the postoperative vomiting. Operations upon the intestines, oöphorectomy, protracted laparotomies in which the bowels are exposed or freely

manipulated, or in which heavy metal retractors are used, predispose to postoperative sickness of more or less intensity.

Special Methods of Prevention.—It is believed by good authority that $\frac{1}{200}$ to $\frac{1}{100}$ grain of atropin sulfate given under the skin before etherization lessens the tendency to nausea and vomiting materially. (Buxton.) "The administration of oxygen immediately after the removal of the anesthetic is a favorite practice with many physicians who claim that the period of recovery from the anesthetic is thereby shortened, and also that the nausea and vomiting are much diminished." ("International Text-book of Surgery.") Lewin says: "The vomiting is frequently due to swallowing of the mucus and saliva containing some of the anesthetic in solution. The anesthetic thus acts as a direct irritant to the stomach, and vomiting is induced by the elimination of the drug through the glands of the gastric mucosa." He suggests two plans to prevent this local effect: (1) a local anesthetization of the gastric mucosa, which may be done by lavage of the stomach with a solution of cocain of 0.05 gram to 0.1 gram cocain in 500 grams water; (2) protect the gastric mucosa from the direct influence of the anesthetic by the use of some indifferent substance which will form a coating over it. For this purpose he suggests the use of a mucilage of acacia, of tragacanth, salep, or a thick decoction of Iceland moss. By changing the position of the patient, all parts of the stomach can be reached. ("Practical Medicine Series," vol. ii, 1901.)

Treatment.—The patient should be kept quiet. If vomiting proves distressing, give a few sips of simple hot water or a small cup of hot tea. I have frequently known a draft of hot water or tea to relieve distressing retching. Hot coffee and champagne have also been recommended. Small doses of cerium oxalate or bismuth subnitrate, or calomel in small and frequently repeated doses, have proved at times highly beneficial. Cold water and ice should be avoided. In our experience they only tend to aggravate the trouble. Sometimes the application of an ice-pack to the epigastrium will give relief. The inhalation of vinegar has been of no value in our hands. Buxton speaks highly of the use of ten to fifteen grains of sodium bicarbonate dissolved in a little hot coffee. In the more aggravated cases, lavage of the stomach with a solution of sodium bicarbonate, together with a hypodermatic injection of morphin, has proved more effective than anything else we have tried. Linevitch advises washing out the stomach with lukewarm alkaline solutions. Blumbul employs plain water for the same purpose and speaks favorably of this

treatment. I have lately tried lavage of the stomach with normal salt solution containing 1 : 1000 solution of adrenalin chlorid with very marked success. If there is a pronounced neurotic element in the vomiting following anesthesia, great benefit may be derived from the use of an enema composed of one teaspoonful of tincture of asafetida to one pint of hot water. Potassium bromid, twenty grains to two ounces of water, is recommended by Hewitt.

POSTOPERATIVE SURGICAL SHOCK.

General Considerations of Shock.—Some surgeons employ the term *collapse* as synonymous with shock; others employ it to designate a condition of shock produced by mental disturbance rather than physical injury. Crile regards collapse as an inhibition of the vasomotor center, in contrast to shock, which is exhaustion of the center. Pure collapse and pure shock may possibly be distinguished in laboratory experiments, but clinically the two are usually so closely combined as to render a distinction impossible, and, so far as the treatment is concerned, they are identical.

The etiology of surgical shock has never been fully determined or satisfactorily explained. The condition is defined by Gould as a "relaxation or abolition of the sustaining and controlling influences which the nervous system exercises over the vital organic functions of the body, the result of a profound impression made on the cerebrospinal axis, either directly through the agency of an afferent nerve or through the circulatory system."

According to Warren, "postoperative shock is a peculiar state of reflex depression of the vital functions, especially of the circulatory system, due to nervous exhaustion resulting from irritation of the peripheral ends of sensory and sympathetic nerves. There is also, apparently, exhaustion of the medulla and spinal cord followed by marked lowering of the vital powers." Goltz's experiments show that exhaustion or paralysis of the vasomotor centers in the medulla is the essential feature, and that this is produced in a reflex manner by disturbances of the sensory nerves. The degree of shock is therefore dependent upon the severity of the irritation as well as the length of time which this continues in existence.

The above views are in accord with the consensus of modern opinion, but it is of vast clinical importance to remember that the diminution of the blood-supply alone or loss of vascular tone may be, and often is,

the most potent cause of serious and fatal shock; for if sufficient in quantity, the loss of blood weakens the heart-action and causes a disturbance of the entire circulatory system. The nervous phenomena in this class of cases is secondary to and dependent upon the loss of the blood-supply.

Hewitt says: "In the treatment of shock, it is well to remember that the symptoms of shock which appear during or immediately following an operation are often so closely interwoven with those induced by toxic quantities of the anesthetic or those dependent upon asphyxia that they may easily be attributed to other causes, or, conversely, the toxic phenomena may be erroneously referred to surgical shock." The degree of shock may range from a mere temporary faintness lasting but a few moments to a more profound protracted condition that may eventuate in death. In determining the character of the shock, the condition of the system prior to the operation, or time required to complete the operation, should be taken into consideration.

Amputation following long-continued suffering and depletion of the system, especially after extensive compound fractures or infected wounds, double amputations or other mutilations following severe crushing injuries, nephrectomy, laparotomies in general, in ileus or for the removal of large tumors with intestinal adhesions, and, lastly, operations upon the brain and spinal cord, are especially liable to be followed by severe and prolonged shock.

All operations should be performed as rapidly as is consistent with good surgery. The intestines should be exposed as little as possible, avoiding all minor measures known to increase shock, such as the use of large metal abdominal retractors, unnecessary jarring of the patient, the employment of dry, warm, sterilized towels and sheets, instead of those wet with aseptic solutions to isolate the field of operation. ("Medical Summary.") Surgical shock may supervene at the moment of first incision, but in the majority of cases it does not appear until toward the close of the operation, or within from one-half to two hours immediately following. In rare instances, twenty-four to forty-eight hours may elapse, this condition being termed "delayed shock."

General Symptoms.—The ordinary symptoms of postoperative shock in well-marked cases are about as follows: The patient may complain of chilliness, have a severe chill, or the symptoms may come suddenly without warning. The patient is cold, faint, and trembling, the face is pale and expressionless, pulse small and rapid. The surface of the body becomes moist with cold, clammy per-

spiration, the nervous system seems to be profoundly affected, the mental faculties show signs of disturbance, there may be incoherency of speech or delirium. There is usually difficulty in breathing, sighing respiration, and other signs of prostration. The body-temperature and pulse are the best guides to determine the severity of the shock, and should always be carefully noted. In the average case the temperature usually falls one or two degrees. A fall of three or four degrees indicates a very critical condition, recovery being exceptional.

Preventive Measures.—When the condition of the patient or character of the operation is such as to predispose to shock, or if there be sudden or unexpected loss of blood, or if from any other cause we recognize symptoms which indicate impending shock, preventive measures should be adopted at once. Since the introduction of anesthesia, the severe forms of shock are not so frequently seen. A simple and efficacious measure for preventing shock is the repeated administration of brandy or whisky several hours preceding the operation. In cases in which we anticipate shock, an ounce of whisky in six or eight ounces of hot water, given ten to twelve hours before the operation and repeated once or twice at intervals of two or three hours, will usually secure a full pulse, allay all previous fear, and render the patient so susceptible to the anesthetic that but little will be required. The effects of this stimulant continue often from ten to forty-eight hours, and thereby prevent secondary shock and exhaustion. (Dennis.)

In operations upon the brain, Dana believes that the danger of shock is lessened by getting through the skull without the use of mallet and chisel, yet Keen habitually employs the mallet and chisel in cranial surgery, without increased fear of shock from this source. Again, in cerebral surgery, as pointed out by Cushing, precise information upon the arterial tension is of value as indicative of approaching shock. In cases of collapse from hemorrhage or shock, and during the course of severe abdominal operations, there is little doubt that similar information will be of value to the surgeon. Many forms of apparatus have been devised to serve this purpose. The Riva-Rocci instrument, which has been in use since 1896 in Italy, and which was introduced in this country in 1900, appears to have fewer defects and more advantages than the other instruments brought to our attention. No special training is necessary to make observations with it, and so far as successive observations on the same patient are concerned, its accuracy is probably sufficient for clinical purposes. It may be that Cushing takes an enthusiastic view

of the matter in his predictions that in appropriate cases the routine observations upon blood-pressure will soon come to occupy the same relative position that pulse and temperature occupy at present. ("Boston Med. and Surg. Jour.")

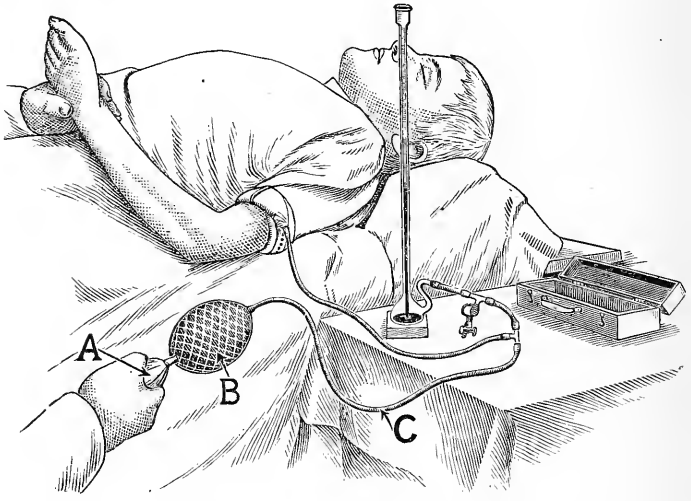

FIG. 5.—COOK'S MODIFIED RIVA-ROCCI APPARATUS FOR DETERMINING BLOOD-PRESSURE.

A. Hand bulb for counter-pressure. B. Distended bulb. C. Rubber connecting tube.

General Considerations of Treatment.—The indiscriminate use of normal salt solution, strychnin, morphin, digitalin, nitroglycerin, and other cardiac stimulants, which has become a matter of habit with many surgeons, is mentioned only to be condemned. The recent experiments by Crile and the conclusions which he has drawn from a series of experiments have awakened general interest. Crile believes that the essential features of surgical shock are the exhaustion or paralysis of the vasomotor centers which control the tone of the peripheral circulation. To the surgeon of to-day, the essential fact brought out by Crile's experiments is that strychnin, the stimulant universally employed in the treatment of shock, is practically of no value, and in pronounced cases may even increase the condition it is intended to relieve. This coincides fully with my personal experience, and I have long since discarded strychnin in certain varieties of shock except as a respiratory stimulant.

For the convenience of the student, and with an effort to formulate a more practical and less incomprehensible understanding of this im-

portant subject, and in order that the reader may have a better conception of the principles governing the rational treatment of postoperative shock which the different causes and conditions require, I have divided the subject into four distinct classes: (1) surgical shock due to vasomotor depression, nervous exhaustion, or vital depression without serious hemorrhage; (2) shock as a result of hemorrhage; (3) postoperative shock from the toxic effects of the anesthetic; (4) shock produced by mental disturbance—sometimes denominated *nervous collapse.*

Surgical Shock Due to Vasomotor Depression, Nervous Exhaustion, or Vital Depression Without Serious Hemorrhage.—The distinguishing features of this type of postoperative shock are: The patient immediately or within an hour or two following the operation passes into a condition of more or less profound prostration. The notable absence of hemorrhage sufficient to account for such condition, the distention of the veins, cyanosis, and the exclusion of possible narcosis from the anesthetic itself, render the diagnosis, so far as treatment is concerned, a matter of little difficulty. The temperature rarely falls more than one or two degrees below normal and the nervous symptoms are markedly prominent. In other words, shock not accounted for by hemorrhage or narcosis from the anesthetic or other obvious causes, indicates general nervous reflex depression or vasomotor exhaustion; the indications for treatment must be directed to arousing or restoring to its normal condition the depressed nervous system. The patient, as in all other types of surgical shock, should be placed flat upon his back, and the entire body wrapped in warm blankets and surrounded on all sides with hot-water bottles.

We object to the Trendelenburg position in this form of shock. The patient, especially if plethoric, when placed in this position will soon exhibit venous congestion of the face, which may tend to aggravate the condition. Capillary congestion of the skin may be relieved by vigorous rubbing, and cloths wrung out of hot mustard-water may be applied to the precordial region.

Treatment of Shock Due to Depression.—Of all heart stimulants at our command for the adult, morphin, $\frac{1}{4}$ grain combined with digitalin, $\frac{1}{50}$ grain has proved in my experience the most effectual. Adrenalin chlorid 1:1000, as suggested by Crile, injected into the infraclavicular or submammary tissues, in connection with morphin, has acted promptly and satisfactorily in the few cases in which we have used it. We prefer to administer adrenalin solution by the mouth (15 to 30 minims of a

1:1000 solution every thirty minutes until reaction occurs). I have never been favorably impressed with the effects of strychnin in these cases; in fact, I now seldom give it except in combination with brandy ¼ to 1 dram, and then only when there is embarrassment of respiration. Atropin, $\frac{1}{100}$ grain, or spartein, ¼ to ½ grain, may be given with advantage. A high enema of warm normal salt solution with 20 to 30 minims of oil of turpentine will also prove of benefit, but hypodermoclysis or intravenous injections are usually not indicated.

Shock as a Result of Hemorrhage.—This is the most fatal form of postoperative shock, depending in degree not solely upon the amount of hemorrhage, but complicated or increased by the symptoms of general shock or vasomotor exhaustion from the blood loss. It is this class of cases that taxes severely the resources of the attending surgeon. Unless the loss of blood has been very sudden or profuse, the symptoms of shock do not develop as rapidly as one would expect. The general symptoms are about the same as heretofore described, except that there is a greater tendency to nausea and vomiting, and instead of venous congestion, we have the pallor of anemia. Respiration is usually feeble but not embarrassed, pulse rapid, feeble, of a running character, or absent at the wrist. There is usually intense thirst, temperature is at first normal, but decreases with the severity of the attack. The fact that there has been severe hemorrhage will warrant the belief that the loss of blood is the direct cause of the shock and treatment must be in accordance therewith.

Treatment of Shock Caused by Hemorrhage.—It is in this variety of surgical shock that so many lives have been sacrificed by erroneously resorting to drugs. To rely upon strychnin or other heart stimulants is folly. The recognition of hemorrhage or loss of blood is vital. The condition must be combated by the retention of a functioning amount of blood in the brain, especially in the respiratory centers. The head and shoulders should be promptly lowered. The Nélaton or Trendelenburg position is best maintained by elevating the foot of the bed some inches. Neither pillow nor bolster should be left under the head. In desperate cases the limbs should be raised nearly to a right angle with the body, and thus held. Instead of this, ordinary muslin bandages may be applied firmly to one or all of the limbs, and compression of the veins and arteries maintained in this manner. Many lives could be saved if the more essential, if not all, of these measures were complied with in the first evidence of impending shock of this character. (Dennis.)

Sudden pallor with increasing pulse-rate immediately following the loss of blood indicates the approach of shock, and the surgeon in charge should recognize at once that the life of his patient is in danger. The patient should be carried to his bed and surrounded, as in all cases of shock, with artificial heat; and stimulants by the mouth or rectum should be given. Rectal enemas of hot water with turpentine act well. Subcutaneously, whisky, ether, atropin, or adrenalin will prove beneficial. If the hemorrhage has been severe, and the condition of the patient indicates further measures, hypodermatoclysis of normal salt solution is the best treatment. High enemas of warm normal salt solution should also be administered every two or three hours, and in the more pronounced cases resort must be had to intravenous saline injection. As the patient rallies, the retentive bandages if applied may one by one be removed. The limbs are then lowered, but the dependent position is maintained until all risk of syncope has passed. As occasion permits, concentrated hot meat essence or milk, hot coffee, tea, etc., must be given—liquids which when absorbed will supply the heart with a bulk of fluid sufficient to go on with its function.

Postoperative Shock from the Toxic Effects of the Anesthetic.—Postoperative shock attributable to the anesthetic itself is of frequent occurrence, being the result of overdosage, idiosyncrasy, or physical condition of the patient from previous disease. The symptoms usually appear during anesthesia, the effects of the anesthetic causing rapid reduction of arterial tension to such a degree as to cause cerebral anemia, and consequently paralytic cessation of breathing. (Hill.) The toxic effects of the anesthetic may, however, continue twenty-four to forty-eight hours or longer following the administration of the anesthetic, and it is this postoperative form to which I particularly desire to call the attention of the reader. The patient has the ordinary symptoms of shock, but of a milder type. Respiration is always more or less embarrassed, pulse slow, feeble, irregular, or intermittent. The symptoms characteristic of this form of shock are: Delayed resolution, embarrassed respiration, frequently of the Cheyne-Stokes character, depressed circulation. These, in the absence of hemorrhage, and especially if this condition follows a minor operation, make the diagnosis of toxemia from the anesthetic certain.

Illustrative Case.—W. H., tailor, aged twenty-two, of slender build and nervous temperament, had a slight cough, heart-sounds and chest expansion

good, pulse 72, respiration normal. Operation 8 A. M.—paraphimosis. Chloroform was administered on Skinner's mask, anesthetic cautiously given. When about to commence the operation, the breathing ceased, and the face suddenly became livid in color and covered with perspiration, hands and limbs cold, pulse imperceptible at wrist. The legs and body were at once elevated, and an attempt to establish artificial respiration rapidly made. A subcutaneous injection of sulfuric ether was given, and amyl nitrite applied to the nostrils; the patient's lips were occasionally rubbed briskly with a towel, as recommended by Hewitt. After prolonged exertion, respiration returned, and the wrist pulse gradually reappeared, although at no time normal. The operation was then performed rapidly. The patient removed to his bed, and head kept low. The conjunctival reflex was present, though very sluggish. Respiration continued very slow and of a Cheyne-Stokes character. Brandy was given by the rectum, and strychnin hypodermatically, also oxygen by inhalation. The patient remained practically in this half-conscious condition for fully thirty-six hours; during this time and for several days immediately following there was difficulty in swallowing, and nourishment had to be administered by the rectum. At no time was there nausea or vomiting. Resort to artificial respiration was repeatedly necessary. The ultimate result was recovery.

Treatment of Shock Caused from Anesthetization.—I have been thus explicit for the reason that I have found these cases constantly overlooked, though of quite frequent occurrence. The treatment for this class is that already mentioned for surgical shock due to vasomotor depression, viz.: partial inversion, artificial respiration, inhibition of oxygen, and application of warmth, etc. If the patient is thin, feeble, and anemic, the intravenous introduction of saline fluid, or hypodermoclysis, with strychnin, adrenalin, or digitalin, is indicated. (Hewitt.)

Shock Produced by Mental Disturbance.—Neurotic and alcoholic patients, or those of a very timid character, especially females and children, even after trivial operations, frequently exhibit all the phenomena of pronounced surgical shock. Fortunately, fatal cases are exceedingly rare, the usual type being mild and transient in character. Excessive joy, grief, anger, or fear, may give rise to prostration varying in severity like that of traumatic or surgical origin. The introduction of a sound into the urethra has been followed by death in a few hours, and the introduction of an aspirating needle into a pleura filled with fluid has been followed by immediate death. So has the opening of an abscess of the finger. Relaxation of the sphincters, polyuria, or induction of profuse diarrhea may be cited as instances of psychic shock from mental

or emotional causes. The state of mind at the time of the operation influences materially its effects upon the nervous system, and as the sensibility of pain varies greatly, so will the postoperative shock. In the language of Jordan, "Where nerve force is predominant, shock also becomes predominant." It is characteristic of this variety of shock that it is often late in developing. The diagnosis is ordinarily easy in the presence of restlessness and excitability, the characteristic expression of the face, especially in children, in the absence of hemorrhage or anesthetic narcosis, and especially when we have reason to believe, from the character of the operation, that the nature of the shock must of necessity be of neurotic origin. I have never seen a fatal case of postoperative shock as the result wholly of psychic causes. Travers, however, describes cases of this character which he characterizes as "shock or prostration" with excitement; the patient, while consciousness lasts, is wild with anxiety, changing his position and struggling for air or breath, and oblivious to everything but his impending fate. Usually delirium of a muttering or violent kind supervenes, and the scene ends in coma. This form of surgical shock is frequently encountered in excessive drinkers, and in the wards of our public hospitals. It is seen in fully one-fourth of the fatal cases of shock. (Hare.)

Treatment of Psychic Shock.—If the disturbance is chiefly mental, the patient, especially if a child, will usually rally speedily if spoken to in a kind and cheerful manner. The principles already enunciated in the treatment of the first class of postoperative shock are applicable to this kind. All active measures or excitement should be avoided, and rest and perfect quiet, as far as possible, should be enforced. Rectal injections of tincture of asafetida one dram to a pint of hot water, or twenty to thirty grains of potassium bromid every two or three hours, are highly recommended in shock of this character. The alleviation of pain with morphin, $\frac{1}{6}$ to $\frac{1}{4}$ grain, preferably combined with atropin, is frequently necessary and tends to hasten reaction.

GENERAL POSTOPERATIVE CONDITIONS.

Acute dilatation of the stomach is a condition which sometimes follows prolonged administration of an anesthetic, and when accompanied with shock may cause grave symptoms, which if not promptly relieved may speedily terminate in death. I have been astonished at the frequency with which dilatation occurs, and yet this fact has not been

recognized or noted by writers upon this subject, so far as I have been able to ascertain. The symptoms usually make their appearance from eight to twelve hours after anesthesia. In patients, as a rule, who have not vomited, dilatation comes on rapidly, pressure of the dilated stomach causing marked distress and disturbance of the heart, the lungs, and the portal circulation. Dyspnea and palpitation of the heart are prominent symptoms, and increase according to the extent to which the diaphragm is forced upward by the stomach distended with gases. If this condition continues uninterrupted, the intestines become involved until there is a general condition of paresis with symptoms of tetany. Tabes facialis is marked and the pulse is greatly increased. Temperature may be but slightly elevated, normal, or subnormal. Palpation readily reveals the trouble, there being marked resonance over the stomach, chest and colon—so marked, indeed, as to be audible for some distance from the patient.

The following case of recent occurrence is typical of the condition:

Mrs. B., aged thirty-four, medium height, well nourished, weight about 145 pounds, blond. Operation 8 A. M. A large fibroid tumor involving both ovaries was removed. The tumor was adherent to the bladder and a portion of the small intestines. The anesthetic used was Squibb's ether; length of administration, one hour and thirty-seven minutes. The patient took the anesthetic well; no vomiting; normal salt solution administered by the rectum at the close of the operation. The patient rallied well, shock not marked, but complained of great thirst, which was controlled by sips of hot water. At 2 P. M. she declined the hot water, complaining of distress in her stomach. At 6 P. M. she vomited profusely and felt very much relieved. I was called again at 11.30 P. M.; found the patient in great distress, pulse 140, temperature 97.6. Dyspnea was pronounced; the patient was very restless, could not lie down, face pale and haggard, marked tympanites over entire chest and stomach, slight twitching of facial muscles and muscles of forearm and fingers, forehead cold and clammy, apparently in a serious condition. Upon the introduction of the stomach-tube gas escaped in large quantities. A warm solution of sodium bicarbonate was used, the stomach thoroughly washed out, and morphin, $\frac{1}{4}$ grain, with digitalin, $\frac{1}{50}$ grain, administered hypodermatically. Relief was immediate and permanent.

Postoperative Thirst.—Postoperative thirst is a matter of great annoyance to the patient, in fact, frequently causing distress more difficult to bear than pain itself. DaCosta and Kalteyer have shown that directly after anesthesia the watery elements of the blood are diminished.

This result is peculiar to chloroform and ether when introduced into the blood either by inhalation or by injection; they also retard the oxygen-carrying elements of the blood and have a direct effect upon the nerves and cerebrospinal centers, impairing both in direct ratio to the amount of anesthetic used. Postoperative thirst is therefore nearly always the direct result of the anesthetic, and this condition is increased in proportion to the amount of blood lost during the operation. Prolonged anesthesia and loss of blood are the prime factors in causing this most unpleasant after-symptom, and in our experience the thirst following ether is greater and more prolonged than after chloroform administration.

To overcome or prevent postoperative thirst has been a subject of inquiry for a long time. It is our custom always to wash out the stomach, after which a high rectal enema of warm salt solution is given. This procedure is universal after all major operations, and before the patient is removed from the operating table. This is done not only to prevent shock and to stimulate the system, but to relieve postoperative thirst. I have often noted after laparotomies in which flushing of the abdominal cavity with hot sterile water is done, and especially when the major part of the fluid is allowed to remain, that the respiration and pulse usually improve and postoperative thirst is greatly lessened. After the patient has partly regained consciousness, the occasional sipping of hot water will frequently give relief or allay the extreme thirst, but cold water even in small quantities invariably causes violent retching and vomiting. If the hot water does not suffice, a little champagne, hot tea or coffee, or, lastly, the holding of cold wet cloths in the mouth, or frequently bathing the lips and rinsing out the mouth with cold water, may suffice for the first six or eight hours, after which time, if all tendency to vomiting or retching has ceased, a trial of a few sips of cold water may be given; if successfully retained, this may be increased until the patient's wants in this respect are satisfied.

Of the new remedies suggested for the relief of postoperative thirst, chloretone seems destined to become the most popular. A five-grain capsule given one-half hour before anesthesia, followed by a three-grain capsule as soon as the patient regains consciousness, has proved very successful in the few cases in which we have used it, but in our experience there is no remedy equal to lavage of the stomach repeated as often as required.

Postoperative Use of Morphin.—The judicious use of morphin,

hypodermatically administered, is of inestimable postoperative value in nearly all major cases. I am well aware that many celebrated surgeons denounce the use of morphin in any form, asserting that it stops peristalsis, locks up the secretions, increasing thereby the danger of infection, and greatly augments the death-rate. Neither actual facts nor clinical history warrant such assertions.

It has been my experience that morphin is frequently indispensable not only to relieve acute postoperative pain, but for the relief of exhaustion or general nervous restlessness which frequently follows prolonged operations. I have seen numerous instances in which, after even an ordinary laparotomy, the patient became exhausted, nervous, or restless, with or without acute pain; the heart-action became rapid and the temperature rose to 102°, 103° F., or higher. In such cases a hypodermatic injection of 1/8 to 1/4 grain of morphin produces a quiet, refreshing sleep, from which the patient often awakes with a normal temperature and pulse-rate.

Indications for the Use of Morphin.—No fixed rule governing the postoperative use of morphin is possible. It should be administered only when actually necessary, and subsequently repeated as infrequently as possible. No morphin should be given, as a rule, until the patient has fully recovered from the immediate effects of the anesthetic, and the mouth, throat, and air-passages are free from mucus and saliva. During the period of reaction pain is frequently acute, but usually transient in character, hence morphin should be withheld. If later the patient suffers severely or is very restless, 1/8 to 1/4 grain of morphin, if given subcutaneously, will afford great comfort to the patient. Larger doses may be needed in exceptional cases.

The susceptibility of the patient to the drug or peculiar idiosyncrasy should be borne in mind. Morphin is especially indicated after amputations following severe crushing injuries or in severe postoperative pain of any character, and especially after removal of the ovaries or a hysterectomy, in which the pain which follows is sometimes excruciating. The use of morphin in conjunction with digitalin in my hands has proved of greater service as a heart stimulant than strychnin or nitroglycerin. In postoperative hysteria or extreme restlessness from any cause the modifying influences brought about by morphin will be sufficiently obvious. The supposed ill effects caused by morphin checking the secretions or inhibiting peristalsis, etc., may be partly overcome by combining strychnin with the morphin. The administration of morphin must

be watched with care and the drug given only in sufficient quantity to accomplish the purpose intended.

Surgeons are too prone to early medication and feeding after operation. Dr. Joseph Price says: "Fuss and feathers and meddlesome management are foolishness. Quiet, absolute, on the back, with nothing for twenty-four hours but those little attentions from a skilled nurse to relieve irksomeness, to provide a cool back, well-rubbed limbs, an empty bladder, a fresh mouth by rinsing, with no opium in the house, will give a cheerful and comfortable patient. It should be noted that patients with the opium habit are highly deceitful, untruthful, and are to be managed by the individual skill of the operator."

CHAPTER V.

TREATMENT OF ASEPTIC AND SEPTIC WOUNDS.

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Postoperative Treatment of Wounds.—The after-treatment of wounds depends somewhat upon whether they are aseptic or septic, and in either case their care deserves close attention to detail. Operative wounds are rarely infected if only reasonable care is taken at the time of the operation. In the changing of dressings the surgeon and his assistants should always observe the same care and aseptic regulations that they do when about to perform a surgical operation. Before the wound is exposed, and before the deeper dressings are removed, the bedding and underclothing should be covered with sterile towels and excluded from possible contact with the wound. The patient's hands must be carefully watched or placed where they may do no harm; the instruments and dressing materials must be in perfect condition. Articles such as bowls, irrigators, syringes, etc., should be absolutely free from infection.

The dressings of aseptic wounds, unless loosened or soiled, need not be changed until the time has arrived for the removal of the stitches, or seven to nine days after the operation. Incisions upon the face, neck, or hand heal much more rapidly. The dressings and part of the sutures may be removed the second or third day. When there is great tension of the skin, in large or ragged wounds, the stitches may be left ten to fourteen days, especially if the skin around the wound does not appear well nourished or the scar firm. Some surgeons are in the habit of changing the dressings the second or third day following the operation. This is ordinarily unnecessary, and only tends to annoy the patient. If, however, at any time the dressings are soiled, or if during the repair or healing of the wound the patient should become chilly or have a rigor, or if there is pain, general restlessness, or sudden rise of temperature, the dressings should be immediately removed, and the wound carefully inspected. If the wound is found infected and inflamed, a sufficient number of stitches should be removed to admit of the free escape of pus if present, and relieve the tension of the skin. No antiseptic irrigation should be attempted at this time. The skin and surface

wound should be cleansed with a solution of hydrogen dioxid, or the wound may be gently irrigated with a hot solution of sterilized normal salt solution. (For the treatment of more pronounced infection, cellulitis, erysipelas, or septicemia, the reader is referred to articles upon these special subjects.)

In amputations, or following septic operations, when drainage is expected or abundant, the dressings may require to be changed in twelve to twenty-four or forty-eight hours. Dressings should be removed when soiled, regardless of time, and changed as often thereafter as indications seem to warrant. After dressing of pus-cavities or open wounds, if packed with gauze, especially appendicular abscesses, it is little less than cruelty to attempt the removal of the gauze in less than four to six days, when adhesions form and the gauze will become loose, admitting of painless removal and repacking. In aseptic wounds the

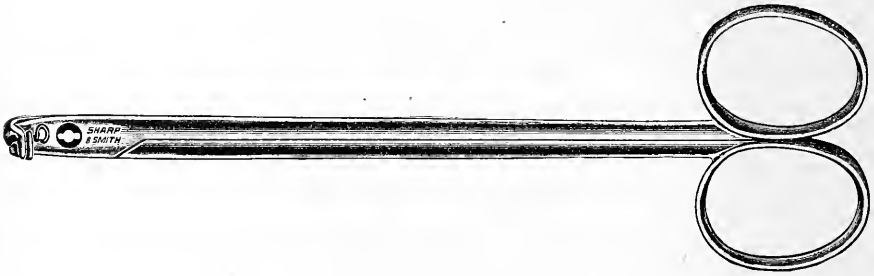

FIG. 6.—ANDREWS' SCISSORS.

dressings should be removed in from seven to nine days, and if the gauze adjacent to the incision adheres, it is best to soak it well with hydrogen dioxid before removing it, the wound being immediately recovered with a clean piece of gauze. If, now, the wound appears to be thoroughly healed, the stitches may be removed. The stitches are cut close to the skin upon one side below the knot, and if of silkworm-gut, by twisting gently and by following the curve of the stiff suture, their removal will cause very little pain. The removal of deep-seated or imbedded sutures is greatly facilitated by means of Andrews's scissors (an ingenious invention of Dr. Frank Andrews, of Chicago). The employment of these enables the surgeon with a little practice to grasp the knot firmly and sever but one side of the suture below the tie. It is sometimes advisable not to remove all the stitches at one time. If all the stitches are removed, and if the wound is found to be dry, firm, and healthy in appearance, a piece of dry gauze the required shape and size should be placed over the

entire wound and the whole fixed with flexible collodion. Should there be any gaping of the skin wound, the edges should be drawn together with small strips of sterilized zinc oxid adhesive plaster, and the wound dressed as before.

After-treatment of the Wound.—Sir Frederick Treves says ("Operative Surgery," vol. i):

"Immense progress has been made of late years in the treatment of wounds. In this progress the most prominent figure is that of Lord Lister. To him belongs the honor of having effected a reformation in surgery, of having established upon a new and scientific basis the ancient art of healing, of having freed the operator from the more grievous of the dangers which surround him, and of having greatly extended the powers and possibilities of the surgeon's art.

"As to the exact method of dressing a wound, and the materials to be used in that dressing, it is impossible to be dogmatic.

"Probably at no time have the modes of dealing with wounds been more numerous, nor has the application of a few common principles been more diverse.

"All surgeons endeavor to secure that the wound shall be quite clean; shall be aseptic; shall not be irritated; shall be kept at rest. One surgeon accomplishes these ends in one way, another in another, and the results are equal. He who considers that his method of dealing with a wound is the most perfect will find that his neighbor, who adopts very different details, obtains an identical measure of success. New antiseptic agents appear from time to time upon the scene. They are pursued, are vaunted as perfect, are diligently employed, and then not a few of them fade away, some very gradually, others with the suddenness of the South Sea Bubble.

"In the after-treatment of the operation wound the part must be kept absolutely at rest. Mere confinement in bed, with the support of a proper pillow, may suffice to effect this, or a special splint or retentive apparatus may be employed. The part is kept raised, so that the circulation of the blood through it may be as much relieved as possible, and is so placed that drainage, if arranged for, may be readily effected. The wound itself is simply dusted with iodoform, and is covered with a thick layer of dry, sterilized wool. Next to the skin a layer of Tillmann's sterilized paper dressing is applied, for the excellent reason that it never sticks to the wound. A bandage is then so applied as to bring pressure to bear upon the wound. The effect of this is that the

edges of the incision are kept well together, the cavity of the wound is obliterated, any tendency to oozing is prevented, the use of a drainage-tube is rendered unnecessary, and the parts concerned in the wound are kept perfectly at rest.

"The 'domet' bandage is best suited for the majority of cases. The bandages used are often unnecessarily thick, and hence in hot weather uncomfortable. Those made of thin 'butter-cloth' muslin are very light and cool. For fixing dressings on the head, neck, and many other parts they cannot be surpassed. There should be a liberal covering of wool, as it tends to equalize and diffuse the pressure employed. The amount of pressure employed must depend upon the circumstances of the individual case. Unlimited pressure would obviously not be employed in cases in which the vascular supply of the part is slight and the patient very old. In certain regions—*e. g.*, the groin—one or more turns of elastic webbing bandage over the ordinary one will be found useful for maintaining even pressure.

"For the last ten years (as recommended by certain American surgeons) I have made a practice of keeping the wound absolutely dry from beginning to end. Microorganisms cannot grow without moisture, and moist dressings and washing of the wound provide this medium. To illustrate the matter by an abdominal incision, the procedure is as follows: The operation area is surrounded by hot, dry, sterilized towels. The sponges used are artificial sponges made from gauze, which are almost free of moisture.

"After the sutures are introduced the wound is dried, dusted with iodoform, and covered with a thick dry dressing of cotton-wool and Tillmann's paper. The bandage or binder is applied firmly. The wound is dressed again on the fourth or fifth day. The dry dressing falls off, and by means of dry forceps the wound is cleared of the caked iodoform powder and little dried blood which cover it. As a matter of fact, the forceps will 'clean' such a wound quicker and more efficiently than a prolonged washing.

"Iodoform and another dry dressing are again applied, and from the perfectly dry wound the sutures are removed on the eighth to the tenth day. In my experience no method of dealing with wounds has given such uniformly successful results as this. The simpler wounds, such as those following the ligature of an artery or the removal of a small growth, need not be disturbed for a week. If much oozing be anticipated in any case, the wound may be dressed at the end of twenty-four hours, and then left for four or five days.

"Sterilized gauze or gauze charged with mercury bicyanid is used very widely as a dressing, and answers admirably. It is the rarest thing to see any irritation of the skin produced by the cyanid, but the results from the use of simple sterilized gauze seem to prove that the antiseptic is unnecessary provided all other precautions are taken.

"Tillmann's 'paper dressing' or 'dressing linen,' already alluded to, is an admirable application for all wounds. It is soft and compressible, and very absorbent, and possesses the great quality of not sticking to the wound."

Jonathan Hutchinson, Jr., of the London Hospital, says: "An ideal dressing for wounds in which some oozing is certain to occur—*e. g.*, excisions of joints—is afforded by a moist sterilized gauze bandage. This is dipped in weak carbolic solution, and applied directly over the wound, and made to cover the limb above and below for some distance. As the bandage dries it contracts, and therefore it must not be employed too tightly. Absorbent wool is applied outside this bandage, and secured with a second one.

"The wounded part should be kept in the open air—*i. e.*, should be as far as possible uncovered by the bedclothes. This will be more or less inevitable with wounds of the head, neck, and upper extremity. The lower limb, after operation, should be quite uncovered by the bedclothes. The atmosphere under bedclothes is limited, is hot, is moist, and is frequently foul, as after the use of the bedpan. The exposed limb may be wrapped up during the cold weather, and in my wards, where no wound of the extremities was ever allowed to be covered by bedclothes, I never heard any complaint on the ground of the part being unduly cold.

"In operations about the pelvis, such as castration and the radical cure of varicocele, the part can be kept in a reasonably healthy atmosphere by a simple arrangement of the clothes over a bed-cradle."

In minor or surface sepsis following operations Pryor recommends the following method of treatment (Pryor's "Gynecology," page 293): "If the sepsis has resulted from a plastic operation the wound should be carefully examined, and if evidences of infection are present the sutures in the center of the involved area should be at once removed and the edges of the wound separated sufficiently to allow of irrigation of the wound. It may be the infection will be about one suture only, but sufficient sutures must be removed to enable the operator to wash out the wound and apply his dressings, even if all must be removed. A

dressing which was devised by the late Professor Van Arsdale has no equal. For instance, assuming the infection to be in the surface of a laparotomy,—and most of them are between the skin and fascia,—enough sutures are removed to expose the involved parts, and after all pus is washed out and the edges of the wound irrigated with normal salt solution, the wound is thoroughly dried. Into such a cavity gauze soaked in a mixture of balsam of Peru 1 part and castor oil 8 parts is introduced, and the whole covered with rubber tissue. This dressing must be renewed every day. Bacteriologic examinations of many thousands of cases have shown that even the most virulent types of streptococcic infection have been controlled by this simple method of treatment. If the infection is in the cervix after amputation, all sutures should be ripped out and the surface painted with pure carbolic acid and the vagina packed with strong iodoform gauze. If after perineorrhaphy the wound becomes infected sufficient stitches must be removed to allow of irrigation." In short, surface infections are to be treated by evacuation and drainage and the application of such sterilized preparations as have been found appropriate to the location in which the infection has taken place.

Principles Which Govern the Treatment of Infected Wounds.—This subject is well epitomized by J. Chalmers DaCosta, Jr., who in a clinical lecture says:

"A wound made by the surgeon after the parts have been carefully prepared for operation is a clean wound, and irritating antiseptics should never be introduced into it. The wound edges are carefully approximated, drainage being introduced only if the wound is extensive; if there exist in it dead spaces that cannot be satisfactorily obliterated by pressure; if the patient is very fat; or if the skin is so tender that it is obviously incapable of withstanding moderate pressure. The wound is dressed with dry, aseptic dressings. These points have previously been dwelt upon.

"Every wound inflicted by an accident is regarded as contaminated from the very beginning. Such a wound undoubtedly contains numbers of bacteria. If it is not properly treated, there will be subsequent suppuration of the tissues or putridity of the blood-clot and of the discharges; and it may even be that there will develop some grave condition, such as tetanus, erysipelas, septicemia, or pyemia. It is the surgeon's duty to cleanse with the utmost care an accidental wound.

"In treating such a wound, we follow the formula already laid

down. In the first place, if the hemorrhage is dangerous, it is temporarily arrested; in the second, if there is serious shock, we adopt the proper measures to obtain reaction; in the third, we remove foreign bodies and cleanse the wound; in the fourth, we permanently arrest hemorrhage; and, finally, we provide for drainage, consider the question of approximating the edges, and apply the dressings.

"The methods of cleansing such a wound depend somewhat upon the nature and the situation of the injury. In an ordinary, clean-cut, incised wound, inflicted, let us say, with a razor or a penknife,—an instrument, that is, of course, dirty, but is not likely to be covered with malignant bacteria,—we should scrub the skin about the wound with soap and water, wash it with alcohol, and scrub it with corrosive sublimate solution, the solution being hot and of a strength of 1 : 1000. The wound itself should be irrigated with a hot solution of corrosive sublimate of the same strength. It should then be irrigated with a normal salt solution, to remove the excess of corrosive sublimate.

"In any region but the face, drainage should be provided for, either by pieces of iodoform gauze or by a drainage-tube. Such a wound about the face may with safety be completely sutured, because the blood-supply is so excellent. In a wound of the scalp, however, capillary drainage should always be provided for by the insertion of silkworm-gut. It is necessary to drain these wounds, unless they are on the face, even though the infection has not been gross; because the necessary introduction of an irritant antiseptic causes a certain amount of tissue necrosis, and increases considerably the flow of wound-fluid. If egress for this fluid is not obtained, the wound will become unhealthy and will not undergo aseptic repair.

"In dealing with a lacerated wound the surgeon carefully examines all the damaged tissue, and the tissue that he regards as hopelessly damaged should be cut away with scissors; for if such tissue is allowed to remain, it becomes necrotic and makes infection inevitable. A lacerated wound should be irrigated with corrosive sublimate and washed with salt solution, and should then have dusted into it iodoform, which may serve to retard the putrefaction in necrotic masses which, to a greater or less extent, are certain to form. It is never closely approximated with sutures. In many instances no sutures are used, the wound being left wide open; in other cases a few sutures are inserted. Such a wound should be drained by inserting a piece of iodoform gauze.

"A punctured wound is very dangerous, even when there are but few

bacteria. It cannot be cleansed unless enlarged by an incision. The rule of treatment in these cases is to sterilize the skin; to make a free incision to the very depths of the puncture; to moisten the skin-edges with alcohol; and to swab out the wound with pure carbolic acid. Half a minute after the acid has been introduced the wound should be swabbed with alcohol. The great germicidal value of carbolic acid has long been known, and the antidotal effect of alcohol has been demonstrated by Seneca Powell, of New York city. Such a wound must, of course, be drained; and this is usually accomplished by inserting a strand of iodoform gauze.

"The details of the management of other forms of wounds and of wounds in particular regions will be discussed under the proper headings. It is necessary, however, to refer here to wounds that are grossly infected by the introduction of, for example, street dirt. Ordinary methods of cleansing will in such a case prove perfectly futile, and the following plan should be pursued: Sterilized olive oil is poured into the wound, after which the wound itself, as well as the skin around it, is scrubbed with soap and water. The oil entangles the masses of dirt, and the soap and water removes the oil with the dirt. After this has been done, the wound may be irrigated with corrosive sublimate, and then with normal salt solution; or, what is better, it should be first swabbed with pure carbolic acid and then washed with alcohol. The skin about the wound is cleansed in the usual manner.

"A primarily infected area should be dressed with hot antiseptic fomentations. The use of heat in such an area is of the first importance: it lessens pain, diminishes stasis, increases the activity of the leukocytes, favors migration, and brings hordes of leukocytes to the part; and the leukocytes not only carry away dead material, but actively attack bacteria and surround the area of infection with an encompassing protective barrier. We therefore employ hot, moist dressings until the wound-discharge is seen to be thin and scanty; and until we are sure that constitutional symptoms will not develop, or until developed constitutional symptoms have passed away. Then, the wound having become an area of granulation-tissue, we can substitute dry aseptic dressings.

"Rest is of the very greatest importance—rest in bed for a severe wound, and rest upon splints for a wound of the extremities. Rest in bed lessens the force and the frequency of the heart-beats, diminishes the amount of blood sent to the inflamed area, and conserves the pa-

tient's strength, consequently increasing his vital resistance. The use of rest, either in bed or upon splints, by lessening or preventing muscular motion, diminishes the danger of the breaking-down of the protective barrier of leukocytes that lies between the wound and the system at large.

"If in spite of all this care a serious infection ensues, and the wound becomes unhealthy or the patient develops constitutional symptoms, we must apply such methods of treatment as I have previously discussed. The surgeon may be called to see a patient that has received a wound a number of days before and whose wound is already diseased. When a wound of this sort begins to show evidences of infection, the surgeon should promptly interfere. The evidences of infection are pain, which becomes pulsatile; discoloration, which becomes dusky; swelling, which at an early date will be accompanied with edema of the skin; and constitutional evidences of surgical or suppurative fever.

"If such a wound has been closed with sutures, some or all of them should immediately be cut, so as to afford drainage. The wound must be gently irrigated with warm normal salt solution. Irritant antiseptics are not used. They are of value in preventing infection, but of little use when infection has occurred, and they may do harm by destroying the barrier of leukocytes. Drainage is to be secured by introducing a drainage-tube or strands of iodoform gauze. If the wound is putrid, iodoform should certainly be used. The part must be placed at rest and dressed with antiseptic fomentations."

CHAPTER VI.

ADJUNCTS OR AIDS IN POSTOPERATIVE TREATMENT.

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Hypodermatoclysis.—Hypodermatoclysis is the introduction of saline fluid into the subcutaneous cellular tissue. The fluid may be introduced by means of a fountain syringe and an aspirating trocar and cannula, but best by a fountain syringe and a properly fitting hollow needle. After the skin has been sterilized, the trocar or needle is plunged into the subcutaneous tissue of the loin, buttock, subscapular region, or submammary region. The best region to use for this injection is perhaps the iliolumbar, the space between the crest of the ilium and the twelfth rib. It is practically the point of least motion in the body, and does not interfere with the dorsal position or cause pain through movements of the limbs or from abdominal or thoracic respiration. The trocar, if this is used, is withdrawn, the cannula being left in place. A fountain syringe previously filled with hot sterile salt solution is used. The ordinary formula used is a 0.6 percent salt solution in boiled and filtered water. One dram of the solution to one pound of body-weight is the maximum quantity that should be used at one time, administered at a temperature of 108° to 110° F. Some surgeons prefer the addition of 25 percent sodium carbonate to 75 percent salt solution, as recommended by Tavel, especially for the irrigation of fresh or infected wounds. Others prefer plain sodium chlorid, the proportion of which should be not less than 6 percent or more than 9 percent. It is still an unsettled question which is the best. A larger percentage of salt is irritating, and increases the danger of necrosis. The stock solution used in Halsted's clinic is as follows: Sodium chlorid 0.9 part, potassium chlorid 0.03 part, calcium chlorid 0.01 part, distilled water 99.06 parts; 50 c.c. of the stock solution is added to 950 c.c. of distilled water. After sterilization it is ready for use. The formula introduced by F. S. Locke has proved most efficacious in our hands. It is as follows: Calcium chlorid 0.25 gram, potassium chlorid 0.1 gram, sodium chlorid 0.9 gram, water 1 liter. The tube of the syringe is attached to the trocar, and the reservoir is hung several feet above the level of the bed. The fluid should run in very slowly, and

absorption will be greatly facilitated by occasionally massaging the infiltrated area. After about a pint has been introduced, the cannula is removed, and the small puncture in the skin is closed with collodion. If the condition of the patient is such that more than a pint must be given, the operation is repeated in another region.

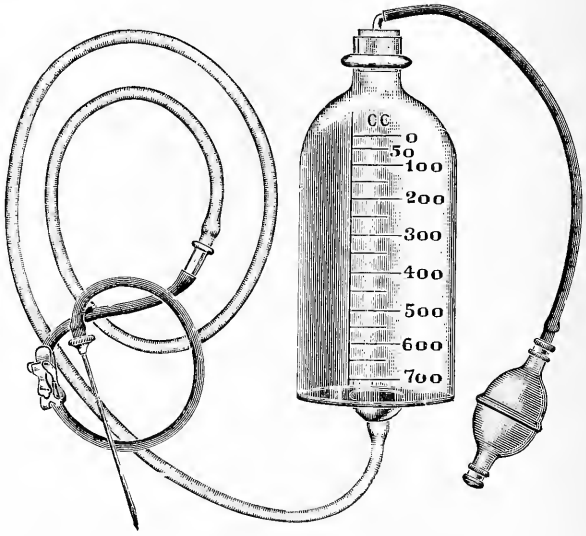

FIG. 7.—HOWARD A. KELLY'S SALINE INFUSION APPARATUS, CONSISTING OF A GRADUATED GLASS RESERVOIR FITTED WITH STOPPER AND FORCE BULB, WITH RUBBER TUBING, PINCH-COCK, AND NEEDLE ATTACHED.

The rapidity of absorption depends considerably upon the condition of the circulation, and with a rapid or feeble heart with poor action of the capillaries, it is a much slower method than enteroclysis. The danger of overdistention here becomes important. If, however, in such a case with the hypodermoclysis we combine enteroclysis with normal salt solution at a temperature of 120° F., the heart is immediately started up and absorption of the subcutaneous fluid occurs more rapidly. For practical purposes the fluid may be injected once, twice, or three times during twenty-four hours, depending upon the reaction and the rapidity of absorption. In an adult six ounces to a pint is indicated in uremia and allied conditions; from a pint to a quart, if there is shock or hemorrhage. Gentle peripheral massage assists absorption. As there is considerable loss of heat in passing through the tube, the fluid should be at a temperature of from 115° to 120° F. Indications for stopping the flow may be deduced from the effects produced by the procedure. Subcu-

taneous injections increase the quantity of fluid in the vessels by replacing that which has been lost by hemorrhage. It adds to the circulation, and, therefore, stimulates a rapid and feeble heart, as in shock; it dilutes the poison and aids in eliminating toxic products through its diuretic action, as in sepsis or uremia; it is asserted by many to have a hemostatic effect, and hence is of benefit in various kinds of hemorrhage. Hypodermoclysis is an operation that should be performed with care and close attention to detail. All dangers of infection may be avoided by proper sterilization of the apparatus used, the solution, and the skin of the patient.

Intravenous Injection.—Intravenous injection of saline fluid is especially indicated in shock, hemorrhage, sepsis, and suppression of urine. One of the most modern and best instruments for this purpose is the Spencer-Collins portable apparatus, consisting of a nickel-plated, flat reservoir, five and one-half inches high by four inches long, and one and five-eighth inches wide, to the bottom of which is attached a force pump with glass barrel surmounted with a metal cylinder, also trocar and cannula of metal. The pump is detachable, thus permitting the various parts to be carried inside the reservoir, making a neat, compact apparatus, all parts of which can be sterilized. When the reservoir is filled and the piston of the syringe is pulled out, one-half ounce of the fluid passes into the barrel of the syringe, and when the piston is pushed in, this amount of fluid is projected through the cannula into the vein. A simple glass funnel, tube, trocar, and cannula make a very satisfactory apparatus and are preferred by many to the more elaborate outfit. After thorough sterilization of the skin, the forearm is partially supinated, and an incision one to two inches long is made over the median basilic vein, through the skin and superficial fascia. With a blunt instrument the adipose tissue is torn through and the vein exposed, and lifted from its bed; two catgut ligatures are carried under the vein and one is drawn toward the distal extremity of the wound and tied securely, thus ligating the vein in continuity. The other ligature is drawn toward the proximal extremity of the wound, and one knot is loosely tied; with a delicate pair of thumb forceps grasp the periphery of the vein and with a sharp pair of curved scissors cut half-way through the diameter of the vein transversely, immediately under the bite of the forceps. This makes a free opening into the vein, guarded by a flap in the grasp of the forceps. The blood now runs out freely, and would obscure the opening but for the grasp of the forceps. Lifting the little flap with the forceps in one

hand, the cannula, with the fluid running to prevent any air entering the vein, is thrust quickly into the opening; the ligature which was only lightly tied is now tied down on the vein and cannula, which thus prevents leakage of the fluid from the vein. When the cannula is withdrawn, this ligature is simply tied firmly down, closing the vein permanently. That part of the vein between the two ligatures may be excised

FIG. 8.—HYPODERMATOCLYSIS.

or let alone. The skin incision is closed with sutures and an aseptic dressing applied to the part.

The quantity of saline fluid to be injected varies according to age, the amount of fluid lost in cases of hemorrhage, and the reaction signs in cases of shock or collapse. In cases in which there has been marked

hemorrhage, the amount should be greater than in simple collapse or shock. The quantity ranges from a few ounces to two or three quarts. The chief guide in all cases is the return of the pulse, with increase in volume and diminution in rate, and the return of color, facial expression, and consciousness.

Locke's solution with or without adrenalin is preferable. The temperature of the solution should be kept at 110° F. The fluid should flow in very gently, and a second injection is rarely necessary, although in cases of prolonged shock or sepsis the injections may be repeated every four to six hours.

Rectal Alimentation.—After many operations rectal feeding is of such importance that the attending surgeon should be thoroughly conversant with the subject. There is a wide difference of opinion as to what constitutes the best preparation or most easily assimilated foods for this purpose. So many formulas have been advanced that are absolutely inert, if not harmful, that I have deemed it best to give in detail what we have found from actual experience to be the most valuable and useful. There are certain foods which the rectum assimilates, and others which it rejects. Starches, oils, and fats should not be given, for the bowel is intolerant of them, and oils and fats, by coating the mucous membrane, prevent the absorption of nutrient material much in the same way that mucus does.

J. N. Jerome ("Int. Med. Jour."), in an article upon this subject, emphasizes certain points as essential:

"1. The quantity and quality of food should be so regulated as to avoid exciting peristalsis, and also that the first injection should be entirely absorbed before another is given.

"2. The irritation, if any, of the bowel should be allayed. Sometimes in extreme irritability opium may have to be used, but it is well to avoid it, if possible. While opium checks peristalsis and favors the retention of the enema, yet it also, to a certain extent, inhibits the absorption of the nutrient material.

"3. The rectum should be cleansed of all mucus, feces, and foreign matter."

The author insists upon great care as to detail, since carelessness may produce rectal irritation and intolerance of food. When properly given, although the enemas may not be retained the first day or two, the proper nutrition can soon be administered in this manner. It can seldom, however, be given a long time without producing diarrheas,

and in these cases it is well to withhold the enemas until the irritation has subsided.

"Hemorrhoids are a severe stumbling-block in successfully using this method, but their presence is not a positive contraindication. In these cases only the softest rubber catheter should be used and local anesthesia of piles established by the topical application of a 2 percent solution of cocain.

"When the enemas are long continued it is well to wash out the rectum at least once a day with warm water, soapsuds, or boric acid solution. By this means all foreign matter is removed, feces are dislodged, and mucus and any remains of a former injection washed away. It is very important to use only those articles of food which are completely absorbed. All other material acts as a foreign body and causes irritation of the rectum."

The best forms of food to employ are among the following:

"Milk.—This is universally used. It should not be too rich, for the fat in the cream is not absorbed, and prevents the absorption of the milk proper. It is well, sometimes, to use predigested milk, and thus save the rectum a certain amount of labor.

"Eggs.—The white of egg is one of the best ingredients of enemas. The yolk should not be used, for it is too rich in fats. It is preferable that the eggs be partially predigested by the addition of a peptogenic or pancreatinizing powder. This may be added to the peptonized milk or to a peptone solution of meat extract. A little salt may be added to the eggs to promote absorption, but it is sometimes irritating to the rectum.

"Alcohol.—Used for rectal injections should be of the best and purest kind. Rum, brandy, or sherry wine may be used, but a good whisky is by far preferable. It can be used in connection with the other rectal foods, but if too strong may precipitate the curds in the milk.

"Meat Extract.—A peptone solution of meat extract may also be used alone or in combination with any of the foods above enumerated.

"Defibrinated Beef-blood.—This also is used to some extent. The beef-blood is prepared by whipping with light switches. The only objection to this is the odor which it leaves.

"All injections should be given at a temperature of from 90° to 95° F. If colder or warmer, they may excite peristalsis and cause

rejection of food. The number of injections depends to a great extent upon the condition of the rectal walls. It is usually advisable to give one every six hours, and then, if retained and absorbed, they can be increased to one every four or three hours.

In giving an enema, it is well to use only a soft-rubber catheter or tube. In the selection of the tube, one should be chosen that is not so stiff as to cause injury to walls nor so soft as to double upon itself if a little force is used. It should be lubricated with sweet oil, vaselin, butter, or glycerin.

"The enema may be given by means of a small hard-rubber syringe, or, as I prefer, a fountain syringe. There should be but little force exerted and the patient instructed not to strain. The tube should be introduced from eight to twelve inches into the bowel. Care should be taken that no air enters the bowel, as it excites peristalsis, and this is prevented by filling the tube with enema just before it is introduced."

There are many special preparations on the market especially recommended for this purpose, but these are not so uniformly successful. Among those which are often employed are peptonoids, panopeptone, somatose, and liquo-peptone, various beef-juices, and other similar preparations.

The following formulas are used in the Philadelphia Hospital:

1. Beef-tea, ...3 ounces.
   Yolk of one egg,
   Brandy, ...½ ounce.
   Liquor pancreaticus, ...2 drams.

2. Beef-tea, ...2 ounces.
   Brandy, ... ½ ounce.
   Cream, ...½ "

3. Beef essence, ...6 ounces.
   Whites of two raw eggs,
   Peptonized milk, ...2 ounces.
   Two eggs.

4. Whites of three eggs,
   Ox serum, ...4 ounces.
   Starch, raw, ...1 ounce.
   Salt, ...1 dram.

Normal Salt Solution.—Many modern surgeons rely solely upon normal salt solution. Ochsner prefers one ounce of liquid peptonoids and three ounces of normal salt solution given every three to four hours by attaching an ordinary glass syringe (piston removed) to a No. 8 or 10 soft-rubber catheter. Insert the catheter two or three inches and pour the food into the glass syringe, which takes the place of a funnel, and let it enter the rectum by its own weight.

We have followed this plan in several instances with the greatest satisfaction. To give nutrient injections successfully, the solution to be used must be at a temperature of 100° F. It should be introduced very slowly and carried very gently as far into the bowel as possible. In many in-

stances a high enema tube is preferred to the catheter. The quantity ordinarily employed should not exceed four ounces. To lubricate these tubes sterile olive oil only should be used.

To facilitate retention a small folded napkin is wet with cold water, and placed directly against the anus and held for a few minutes; this will usually overcome any tendency toward tenesmus. The bowels should be cleansed at least once each day by copious but gentle enemas of normal salt solution.

Subcutaneous Feeding.—When forced feeding is necessary, and when no nourishment can be taken by the stomach, and especially when there is rapid emaciation from want of nourishment, and frequently if the rectum has become so irritable that enemas cannot be retained, one to two ounces of sterilized olive oil may be injected into the subcutaneous tissue of the groin. The oil must be introduced very slowly, and should not be repeated more than once in twenty-four hours. A 10 percent solution of grape-sugar has been highly extolled by English surgeons for this purpose, but seems to cause considerable irritation at the site of injection.

Inunctions.—A certain amount of nutritious matter can be introduced into the body by inunctions. The skin must be prepared by means of sponging with soap and water and by frequent light massage. The materials usually employed are sterile olive oil, or cod-liver oil two parts and alcohol one part. George Boody has used with success leaf-lard inunctions applied thoroughly twice daily to the chest, abdomen, and back. The patient's strength is undoubtedly increased by such treatment.

Bandaging.—"The object of bandages is not only to hold in place surgical dressings and splints, but they are frequently employed to exert pressure on certain parts, control hemorrhage, relieve congestion, promote absorption of extravasated liquids or exudates, to prevent edema, support circulation, weaken vessels, correct deformities, as well as to give protection and support to injured limbs and joints." (Brewer.)

Bandages are made of gauze, flannel, cotton, linen, india-rubber, and unbleached muslin. They vary in width and length. According to Wharton and Curtis, bandages for the hands, fingers, and toes should be one inch wide and three yards long; for the extremities in children, two inches wide and six yards long; for the extremities in adults, two and a half inches wide and seven yards long; head-bandages, two inches wide and six yards long; thigh and groin bandages, three inches wide and nine yards long; trunk bandages, four inches wide and ten yards long. For ordinary purposes the best material for bandages is unbleached

muslin, which is first washed in sodium carbonate solution to remove the sizing, and is then torn in strips of the desired width and length. The selvage is removed and the strip is made into a roll.

In postoperative work, when employed for the purpose of retaining dressings, the application of the bandage may be begun at any part of the limb below the wound, and the bandage is then carried to the point where the dressings are to be covered. After such a bandage has been applied, if the patient complains of too much constriction, the first turns should be cut with scissors. If a bandage is to be used to make pressure on any portion of a limb, its application should be begun at the fingers or toes, and the bandage should be carried up to the place where the pressure is needed. "Compression should not be made in the middle of a limb by a tightly applied bandage without having first included the fingers or toes, as such a procedure would produce pain, swelling, and edema, and, if prolonged, might cause gangrene." (Hare.)

Bandages to Give Support and Make Compression.—If we are dealing with a condition which is in need of support and compression, such as a slight sprain, a swollen joint, varicose veins of the leg, or eczematous ulcers of the lower extremities, bandages made of some elastic material should be used, such as flannel cut on the bias, elastic webbing, or india-rubber. There are two forms of india-rubber bandage which have special names: one which is very thin, and made of rubber similar to that employed in making rubber dam, is known as Martin's bandage, and another, made of web-elastic and known as Randolph's bandage. They may be used for practically the same purposes. Martin's bandage is used in the palliative treatment of varicose veins of the leg. Its application may cure an ulcer of the leg caused by varicose veins, but it would best be used as a prophylactic measure in varicose conditions, or worn to prevent a recurrence of the leg ulcer once it is cured. This bandage when applied will give an elastic support which will have a tendency to turn a flow of venous blood from the superficial veins into the deep veins. In this condition the Martin bandage should be applied while the leg is slightly elevated and before the patient arises in the morning; it should not be removed until he has retired at night, and after it has been removed it should be washed with soap and water, dried, and hung up until morning.

When it is desired to make pressure or support, in case of sprain, varicose veins, effusions, etc., the flannel bandage is most useful when cut bias and made of sufficient length, as it is then much more elastic than when cut straight.

Methods of Applying the Roller Bandage.—If the part to be bandaged is of even size throughout, as the upper arm or trunk, the free end of the bandage is laid upon the part and held in place by the left hand, while the roller is carried by the right hand around the part to be bandaged in such a way that the second turn will hold the first firmly in place. Each revolution of the bandage covers at least one-half of

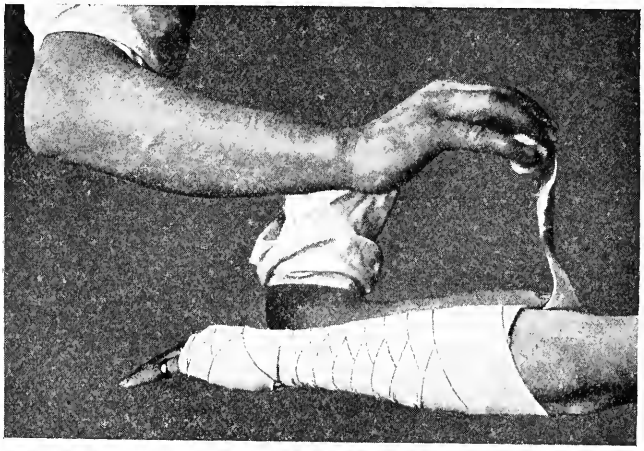

Fig. 9.—Spiral Reversed Bandage Applied to Forearm.

Fig. 10.—Spiral Reversed Bandage Applied to Leg.

the last turn. When the upper limit of the bandage is reached, the end is pinned to the layer beneath. If the part to be bandaged is conical, as the leg or forearm, the spiral reversed bandage is applied, in which each turn is made to fit snugly to the limb by being turned upon itself, as seen in Figs. 9 and 10; or the figure-of-eight bandage is employed, in which the lower loops of bandage are snugly and evenly

adapted to the limb, and as the bandage ascends they eventually cover the more loosely applied upper loops. On the leg this is by far the better bandage for ambulatory patients. Properly applied, it will remain in position for days; the spiral reverse is prone to loosen and slip down (Fig. 11). In applying a bandage to the groin or shoulder, the spica is employed, beginning on the limb and making a figure-of-eight around the limb and trunk, as seen in Fig. 12. In bandaging the groin, however, especially in ambulatory patients, this bandage will remain in position much better if a few turns are carried directly around the waist (Fig. 13).

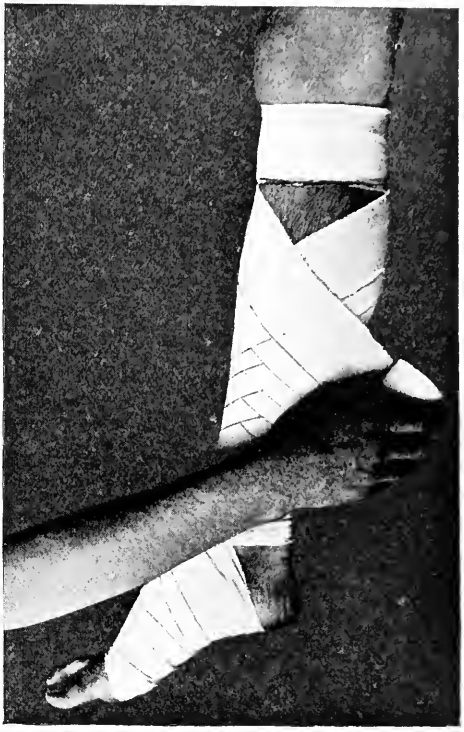

FIG. 11.—FIGURE-OF-EIGHT REVERSED BANDAGE APPLIED TO LEG.

In bandaging the thumb or one of the fingers, the free extremity is covered with the spiral reversed; and when the base is reached the spica is used, the upper loop of which encircles the digit and the lower loop the hand and wrist (Fig. 14).

In bandaging the knee, the figure-of-eight is used, the first turn being taken around the joint opposite the middle of the patella, after which the loops alternate, one being applied above and the next below the first turn (Fig. 15). In bandaging the head, one or two loops are made to encircle the head, passing from the frontal region just above the eyes around the occipital protuberance; the bandage is then applied in a transverse direction, beginning just above one ear and carrying the first turn over the center of the vault to the opposite ear; then a number of turns are taken between these two points alternately in front of and behind the first until the entire vault is covered. The loops made by reversing the bandage just above each ear are firmly held until all the trans-

verse turns are made, and finally secured by three or four encircling turns around the forehead and occiput, safety-pins being finally introduced

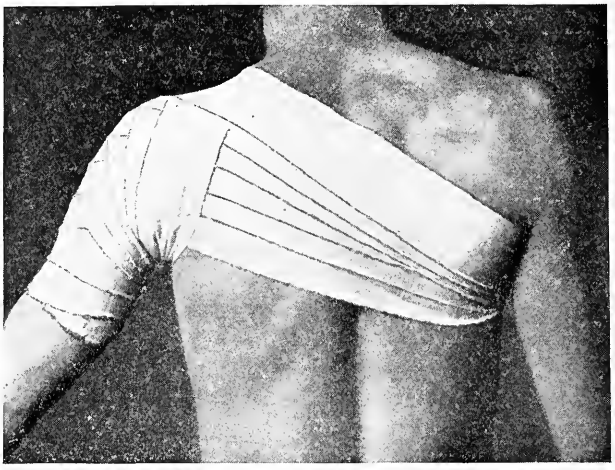

FIG. 12.—SPICA BANDAGE APPLIED TO LEFT SHOULDER.

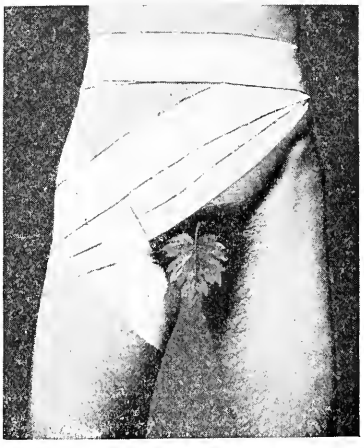

FIG. 13.—SINGLE SPICA BANDAGE ENCIRCLING THE WAIST.—(*After Bassini.*)

to hold all in place (Fig. 16). The folds covering the vault may also be made longitudinally if desired (Fig. 17).

In bandaging an amputation-stump, make one or two circular turns around the circumference of the stump, then a number of recurrent

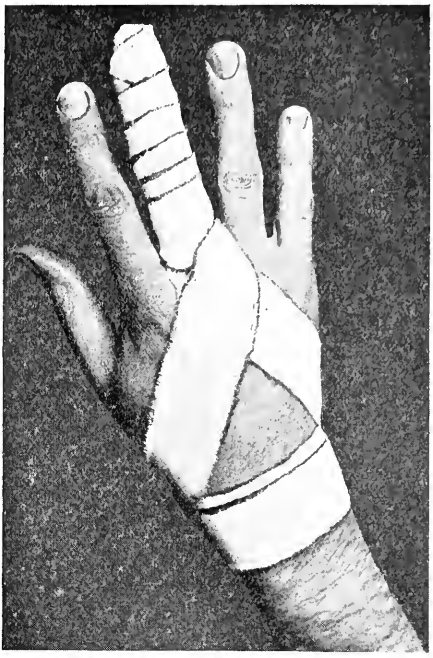

FIG. 14.—SPICA BANDAGE APPLIED TO FINGER WITH LOOP OF HAND AND WRIST.

FIG. 15.—PROPER METHOD OF APPLYING BANDAGE TO KNEE.

turns at a right angle to these, inclosing the extremity, and holding these

in place by a circular or reversed spiral from the extremity upward until a joint or some bony protuberance is covered to hold it in place.

THE MODIFIED VELPEAU BANDAGE FOR HOLDING THE ARM SECURELY TO THE CHEST-WALL.—Place the hand of the injured side on the opposite shoulder; take two or three turns of a wide roller bandage around the thorax, including the arm; then pass the bandage from the free axilla behind to the fixed shoulder, passing over this shoulder from behind forward; carry the bandage around the point of the elbow and then upward behind the same shoulder over its summit downward in front to the free axilla, then circularly around the chest, alternating these turns until the entire arm and chest are included (Fig. 18). All these methods may be modified to meet special indications.

FIG. 16.—GIBSON'S BANDAGE. —(*Wharton.*)

FIG. 17.—MODIFIED BARTON'S BANDAGE. —(*Wharton.*)

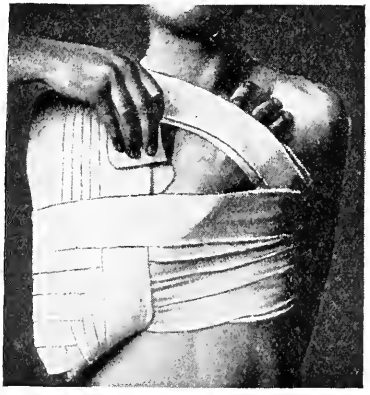

FIG. 18.—SPICA BANDAGE APPLIED FOR OPERATIONS ON SHOULDER OR CLAVICLE.

The triangular or folded handkerchief bandage is made by folding a square piece of muslin or gauze into a triangle. This can be applied over a bulky dressing of the hand or amputation-stump by placing the base of the triangle at a right angle to the limb and folding the apex over

its extremity, and securing it by wrapping the two extremities of the base snugly around the limb and tying them. This bandage may also be employed on the head.

THE T-BANDAGE is used for dressings applied to the perineum, the horizontal arm encircling the trunk, the perpendicular arm passing between the thighs from behind upward and fastened to the front of the body portion.

THE ELIZABETH TROTTER MANY-TAILED ABDOMINAL BANDAGE, as recommended by Brockman, is applied as follows: Unroll the bandage enough so the middle strip will come just under spine and parallel with it, then let each end drop over the side of the table as it unrolls. Begin at the top on one side and bring the upper tail across body at a slight angle with the body, then bring the top one from the opposite side over and across it at same angle.

Then proceed the same with each succeeding pair of tails till they are all on. One or two safety-pins will fasten the last ones and they will bind or hold in position all the rest of the bandage. The advantage of this form of bandage is that it will fit any form of abdomen and fit it perfectly.

FIG. 19.—SODIUM SILICATE DRESSING.—(*Hare.*)

The many-tailed bandage is useful for almost any part where dressings are frequently changed. It is particularly serviceable when a firm abdominal binder is required and in breast amputations.

THE TWO-TAILED JAW BANDAGE is useful for holding the lower jaw firmly against the upper, as in fractures of the lower jaw or in wounds of the chin.

THE SLING, TO SUPPORT THE FOREARM AND ARM, is made by folding a large piece of muslin into a triangle. Place the two extremities

of the base-line around the neck and allow the forearm to rest in the loop.

The Sling and Chest-binder.—This is a very useful bandage for fixing the arm to the chest, and is used in fractures of the clavicle and humerus, injuries to the shoulder and elbow. Place one extremity of a triangular sling in place around the neck, flex the elbow, and place the forearm across the chest; then apply a chest-binder including the upper arm, and fix with safety-pins, after which the other extremity of the sling is folded around the forearm and carried upward around the neck and

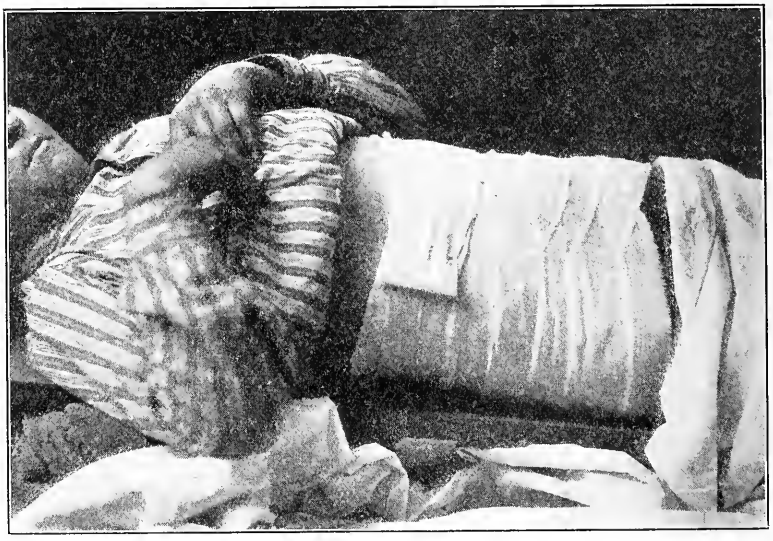

Fig. 20.—The Many-tailed Abdominal Bandage.

tied to the one already in place; fasten all these layers together with safety-pins.

Adjuncts to Postoperative Treatment.—Of the many modern appliances invented for the comfort and management of patients, we can refer to but few, and that briefly. Many of these inventions are not perhaps actually necessary, yet they prove of value in so much that they contribute materially not only to the comfort of the patient, but simplify and facilitate the after-care, and should therefore be obtained when possible.

The fracture-bed, especially for use after compound fractures, is

now almost indispensable. There are several varieties or patterns, all

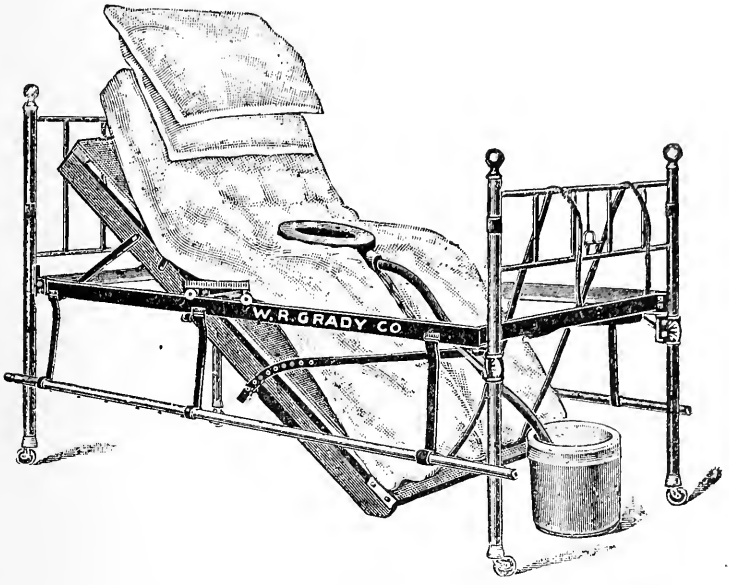

FIG. 21.—MUNGER'S INVALID BED. WITH MATTRESS RAISED TO SEMI-SITTING POSTURE AND BEDPAN IN PLACE FOR USE.

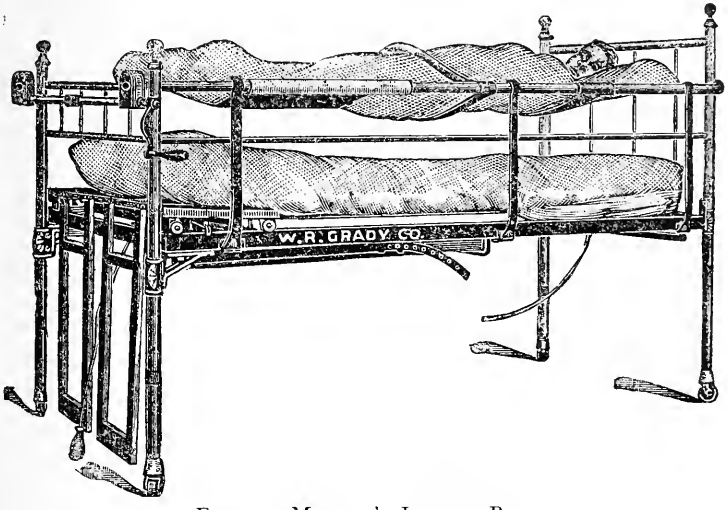

FIG. 22.—MUNGER'S INVALID BED.

of which have proved exceedingly useful. Fig. 21 illustrates Munger's invalid or fracture-bed. Fig. 22 illustrates the mechanical adjustment.

The mechanism of the fracture-bed permits elevation of the head and trunk to a sitting position without disturbing the fracture. To the seat-board are attached two limb supports, each working independent, and so

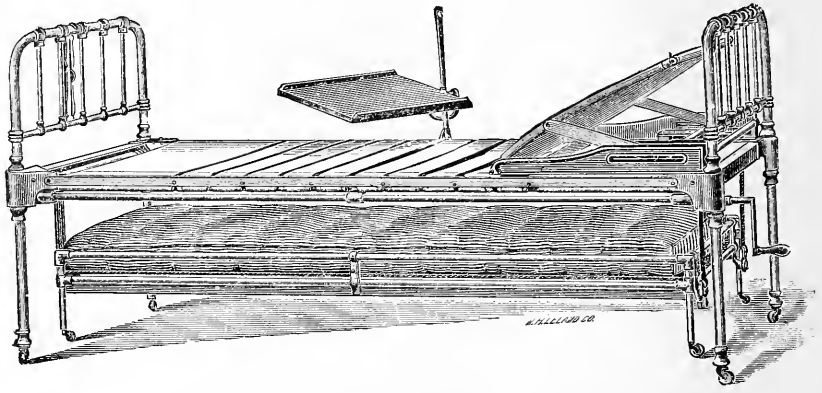

FIG. 23.—CROSBY'S INVALID BED.

situated that one or both of the lower limbs may be placed at any desired height without regard to the position of the patient's trunk. A longitudinal central slit in the hair mattress permits the introduction of a bedpan, and thus avoids lifting or elevating the hips.

THE CROSBY INVALID BED, which is popular in some hospitals, is illustrated by Fig. 23.

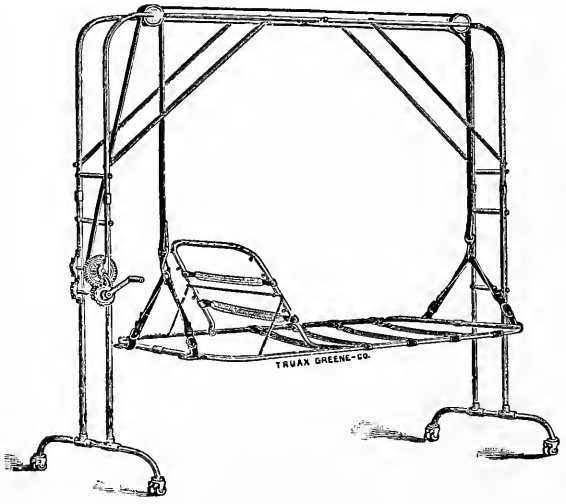

FIG. 24.—LIFTER FOR RAISING OR LOWERING PATIENT.

THE "MICHAEL REESE HOSPITAL LIFTER" is shown by Fig. 24. It is of great utility in the treatment of various complications. This device is indicated for use in cases in which it is desired to raise helpless patients from a bed.

The apparatus is well shown in the illustration, and is of such

construction that by means of a crank and geared mechanism a patient of any weight may be lifted either for the purpose of rest or transfer to another bed.

SICK-BED CHAIR.—Among the recent inventions of great utility is that of Moore's sick-bed chair. By its use but one attendant is required, and the patient can be handled with ease and comfort. The following cuts, Figs. 25, 26, and 27, illustrate the method and manner

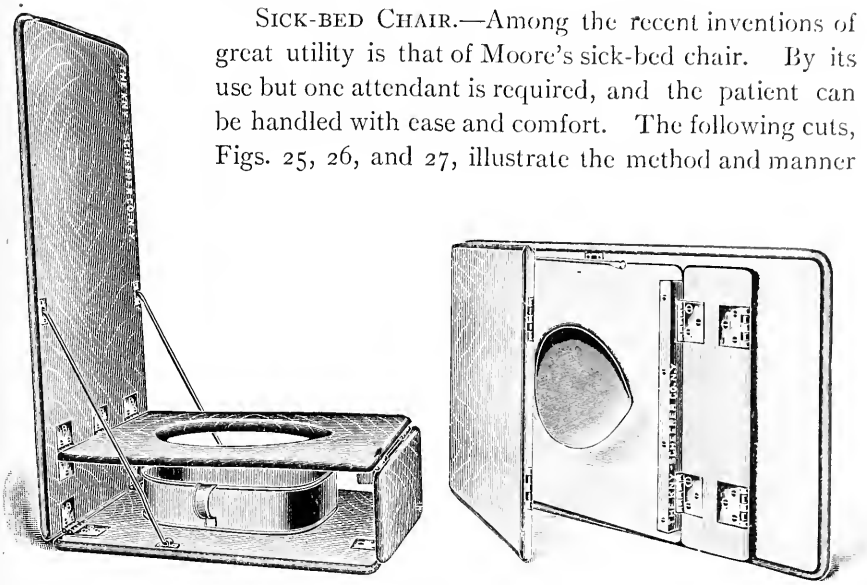

FIG. 25.—MOORE'S SICK-BED CHAIR.

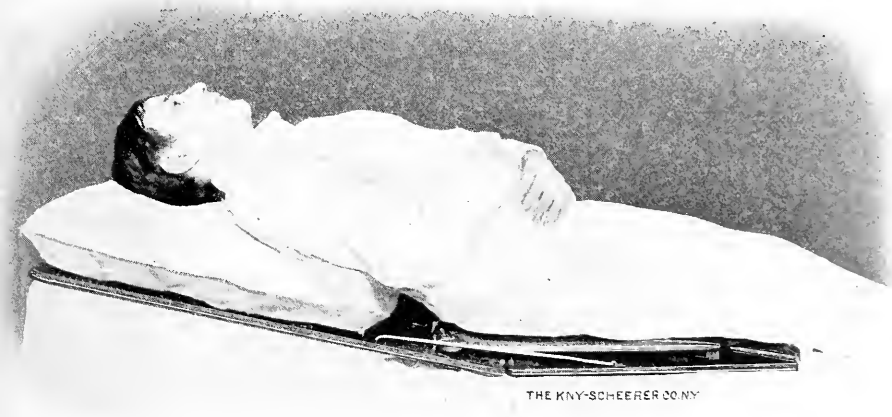

FIG. 26.—MOORE'S BED CHAIR—PATIENT IN RECLINING POSITION.

of usage. It is not only useful, but is highly appreciated by patients, owing to its simplicity and efficiency.

It is made of light wood and folds into a compact form, and by elevating slightly or turning the patient partly upon the side can be easily placed into position. The patient may then be elevated to the sitting position if necessary, with little exertion on the part of the attendant.

FIG. 27.—MOORE'S BED CHAIR—PATIENT IN ERECT POSITION.

The illustrations explain the apparatus more fully than any lengthy description would.

THE MEDICO-MECHANICAL MASSAGE APPARATUS, as illustrated in Figs. 28, 29, and 30, is a very valuable adjunct in the after-treatment of dislocations and fractures, for the correction of joint motion or muscular impairment. This apparatus is used in many of the European clinics. It is so constructed as to allow natural movements of the various joints and muscles, and is regulated by weights or counterbalances. These

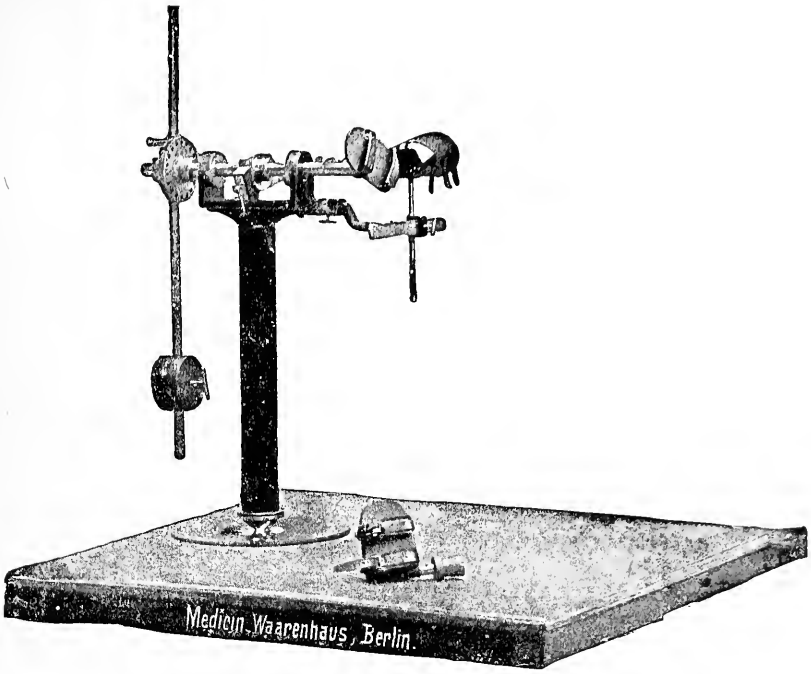

FIG. 28.—MEDICO-MECHANICAL APPARATUS.

FIG. 29.—MEDICO-MECHANICAL APPARATUS, AS APPLIED FOR ANKYLOSIS OF THE KNEE.

may be so graduated as to conform to the amount of action or motion of any joint or muscle; for instance, with a patient suffering from partial ankylosis of the knee with only a slight movement of the joint, the apparatus is so adjusted to the limb to suit the requirements of the case, and so that the limb can be carried but little beyond the point of resistance. Continued use gradually increases the action of the joint movement,

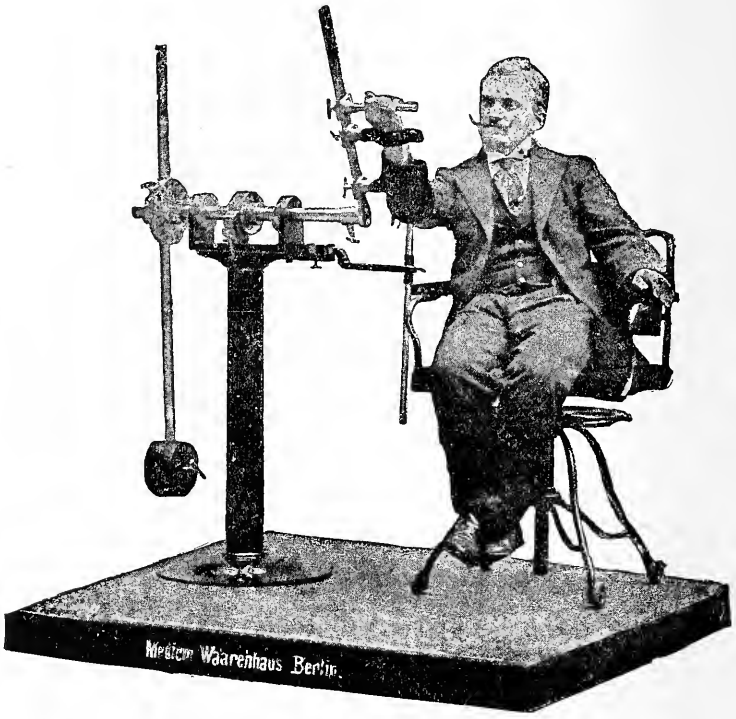

FIG. 30.—MEDICO-MECHANICAL APPARATUS, ADJUSTED FOR ANKYLOSIS OF THE ELBOW.

finally effecting complete restoration. The great value of the apparatus lies in the fact that the treatment on the part of the patient is self-induced. The cuts fully illustrate the method of application of its various attachments.

CHAPTER VII.

HEALING OF GRANULATING WOUNDS.

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Healing of Granulating Surfaces.—The process of repair upon granulating surfaces, the manner through which healing is produced, and the best means needful for local treatment, is still an open question, as shown by the different methods employed by surgeons at the present time. All agree that physiologic rest is the essential feature in the treatment; *i. e.*, complete repose, obtained through the application of proper splints, confinement in bed when necessary, and, lastly, the aseptic and antiseptic protection of the granulating surfaces. In the healthy or normally healing surfaces but little treatment is necessary, except protection of the surfaces, prevention of external irritation, etc. When temporary sloughing or unhealthy healing becomes manifest, various stimulating agencies, such as silver nitrate, zinc chlorid, and balsam of Peru are applied to stimulate or spur sluggish granulation. Aqueous solutions, if mild and nontoxic, permit easy and efficient washing of the surfaces. Balsamic preparations are of use in specific forms of ulcers. The dressing which adapts itself most perfectly to the factor of rest and asepsis is the best possible treatment for acute granulating wound-surfaces. (Kocher.)

To subject the surfaces of granulated wounds to the action of chemical irritants, hydrogen dioxid, mercuric chlorid, carbolic acid, etc., is harmful rather than useful, owing to their tendency to destroy the delicate granulations and new epithelium. The skilful management of granulating wounds requires long training and a knowledge of the pathology of repair. As a stimulant to unhealthy granulating surfaces, the use of gold-beater's skin, as suggested and prepared by Outten, of St. Louis, has proved of such great value in our hands in prolonged aggravating or unhealthy granulating surfaces that I give herewith his method in detail:

"Large and perfectly cleaned sheets of gold-beater's skin are selected. The sheets are put in hot sterilized (not boiling) water, sufficiently hot not to interfere with the texture of the skin, from 98° to 100° F.—a stream of hot water preferred. After having remained in the hot water

sufficiently long to cleanse them, they are then taken therefrom, and squeezed as free from water as possible. A solution is now ready, made of the following agents:

Cobalt chlorid,	1 ounce.
Gold chlorid,	1 dram.
Distilled water,	10 drams.

The skins are now put in this solution so that it entirely covers the skin in any container that may be used. After the skins have been put in the container holding the gold-cobalt solution, two ounces of the oil of cinnamon is poured in on the skins now immersed in the gold-cobalt solution.

"The sheets of gold-beater's skin thus prepared are kept in a wide-mouthed, glass-stoppered container, immersed in the chemical solution of oil of cinnamon, as above mentioned. When the membranes are used upon a granulating surface, the following is the method indulged in: A piece of the treated membrane of sufficient size to well cover the entire granulating surface is cut. This piece is applied to the granulating surface after the following course is pursued. It is put in alcohol and allowed to stay in the alcohol from three-quarters of an hour to an hour. It is then taken out of the alcohol and put into hot water from 98° to 100° F. The membrane is put in the alcohol for the purpose of removing any excess of the oil of cinnamon, thus preventing heat and pain likely to come from the irritating stimulation of the cinnamon oil. After the membrane has remained in alcohol sufficiently long, and then put into the water to remove the excess of alcohol, the skin is dried by putting it between the layers of a sterilized towel or cloth. A few punctures are made through the membrane, which is now applied to the granulating surface. The membrane thus applied is now covered with six or eight layers of sterilized gauze. Another piece of membrane is then applied on top of the gauze large enough to strain the air in its access to the wound. The membrane thus applied on the sterilized gauze need not be put in the alcohol, but simply squeezed between the folds of a cloth to remove the excess of the solution contained on the membrane. Now there is put on this membrane a layer of sterilized cotton, and then a retaining bandage is applied. It is thus seen that a needed and well-timed discipline is here indulged in for the application of the gold-cobalt membrane. The dressing thus applied to the granulating surface is allowed to remain intact for at least forty-eight hours.

"After the first application of the gold-cobalt membrane to granulations they assume a bright, vivid, healthy hue (bright as blood can make them), looking firm, erect, even, and healthy. Besides this, the epithelial border appears to be stimulated in a remarkable manner. It is readily demonstrable that after the application of the gold-cobalt membrane a minimum amount of interference with the granulating surface is obtained. There is no necessity of friction in cleansing the surface, as when unguents are used. The lightest touching of the granulating surface when cleansing seems to be sufficient.

"As an aid in the perfect establishment of skin-graft it is an ideal method, whether we use it in the Reverdin or Thiersch method. In the Thiersch method, when used with the membrane, every graft appears to live and flourish. When the Thiersch method is used, the granulating wound-surfaces and grafts are prepared with the saline solution, as is usually done. The gold-cobalt membrane is put in alcohol the same as in the treatment of granulating wounds. It is washed out with hot water, and then put into the normal saline solution until it is thoroughly soaked and permeated. After the grafts have been applied to the granulating surface, from one to four perforated gold-cobalt membranes are applied. I generally apply two membranes, and after forty-eight hours, upon examination, the grafts will be found in a healthy condition and adherent to the granulation. The salt-water gold-cobalt membrane is again applied for another forty-eight hours. After this time the regular alcohol-treated membrane surface may be applied. When these grafts are applied upon a fresh curetted surface with treated membranes in position, great impetus to the healing process is manifest."

SKIN-GRAFTING.*

When the removal or destruction of integument has been so extensive that cicatrization cannot be effected on account of the tension of the parts involved, skin-grafting should be practised. There are three recognized methods—grafting, sliding, and transplantation in mass. Sliding and transplantation in mass are usually performed at the time of the operation. As skin-grafting, however, is frequently a postoperative measure, the ordinary technic is described in detail. There are two recognized methods of skin-grafting, known as Reverdin's "epidermis-grafting" and Thiersch's "skin-grafting."

* Abstract from Cheyne's "Manual of Surgical Treatment," Lea Bros. & Co.

In Reverdin's method small thin portions of the superficial layer of the skin are snipped off with curved scissors. Pieces about the size of a hempseed are planted on the surface of the granulations at short distances from each other; epidermic growth occurs from each of these little points, and the result is that numerous small islands of epithelium form over the surface of the sore. If the grafts are close enough together and the other conditions of healing are favorable, these islands of epidermic growth soon coalesce, and in this way rapid cicatrization is obtained. It is necessary that these grafts should not be too far apart, because, as a rule, they have only a limited power of reproduction. Usually each graft gives rise to an island of epidermis about the size of a sixpence, and then growth seems to come to a standstill. The result of this method of epidermis-grafting is that rapid healing is obtained in many cases, more especially in burns and sores on the trunk, where the skin is freely movable over the deeper parts. Further, the contraction of the subsequent cicatrix is considerably diminished, because less granulation tissue is formed than if the sore has to heal altogether from the margin, and the amount of contraction depends entirely on the amount of young granulation tissue produced. Nevertheless, a considerable amount of contraction will inevitably occur when healing has been obtained in this way, and the resulting scar is not materially stronger than that obtained by permitting the sore to heal from the edge.

Thiersch's Method.—With a view to obtaining a sounder scar, much more extensive and thicker portions of the skin must be taken, and the grafts must be applied close together. This is known as Thiersch's method. In this method the skin which is to be used for the grafting must first be thoroughly disinfected in the usual manner, namely, by turpentine, soap, and strong mixture, and it must also be carefully shaved. The presence of hairs on the grafts seems to interfere materially with their union. The skin of the front of the thigh or the flexor surface of the forearm is usually employed for the purpose.

Preparation of Wound.—(*a*) Preliminary.—The wound itself must also be prepared beforehand. It is of no use to graft a wound which is actually ulcerating; it must be brought into a healthy condition, and healing must have commenced before grafting is likely to be successful. The best criterion that healing is taking place is the presence at the edges of the dry red line which indicates recently formed epithelium. Some surgeons wait for a considerably longer time before grafting, in order to get a firm layer of granulations, but our experience is that, so

soon as healing begins around the edge, the wound may be safely grafted upon. A second essential is that the wound shall be aseptic. If it is suppurating, and the discharges are septic, the graft—which is, after all, merely a piece of dying tissue—will become impregnated with decomposing pus, and will rapidly become loosened, die, and undergo decomposition. The methods of rendering the wound aseptic have already been described.

(*b*) Operative.—With a wound that is aseptic and beginning to heal, the following is the method of procedure: The patient having been put under an anesthetic, the granulations over the whole surface of the wound are evenly scraped away, taking care, however, to remove only the soft layer of granulations and not to go through the deeper one of newly formed fibrous tissue into the fat. A surface is thus left which is smooth, highly vascular, and firm, and consists of the deeper layers of granulation tissue which have already become organized into fibrous tissue. One is tempted to limit the skin-grafting to the parts actually unhealed, but if this is done the result will, as a rule, be very disappointing, for, while the part that has been grafted remains perfectly sound, the margin where spontaneous healing has occurred is very likely to break down, and thus a narrow line of ulceration appears later on at the site of the edge of the wound. Having then removed the layer of granulations in the manner described, and cut away the newly healed edge of the wound, the next thing is to arrest the bleeding completely before applying the grafts. This is best done by pressure, but, if pressure is applied directly to the sore either by sponges or dressings, it will be found that the bleeding begins again when they are removed, because they stick to the raw surface. The best plan is to interpose a piece of protective sterilized oiled silk covered with a layer of dextrin, which prevents adhesion of the sponges to the sore and thus avoids a renewal of the bleeding on removal. Hence, when the scraping and cutting are finished, any spouting vessel is clamped, and a large piece of protective dipped in the 1 : 2000 mercuric chlorid solution is applied over the raw surface. Outside of this several sponges are placed, and a bandage dipped in 1 : 2000 mercuric chlorid solution is firmly bound over them, or, if the wound is small and an assistant available, he may apply the pressure.

Cutting the Grafts.—While the bleeding is being arrested by pressure, the surgeon proceeds to cut his skin-grafts. In Thiersch's method the grafts may be taken from any part of the body, but, as a rule, they are most conveniently cut from the front of the thigh. The skin

having been disinfected, the surgeon grasps the thigh from behind with his left hand, keeping the skin as tense as possible, and also making it prominent and flat by pushing the muscles and skin forward from the bone. The skin is further put on the stretch vertically by an assistant who pulls it upward at the groin and downward at the knee. The razor, which should have a very broad blade, is dipped in boric acid lotion or normal salt solution, and is constantly kept wet by this solution while the grafts are being cut, just as in making microscopic sections of fresh tissue. If this irrigation is not maintained, the graft tends to adhere to the razor and may be either partially or wholly cut through before a sufficient length has been obtained. The razor is made to penetrate through about half the thickness of the skin, and then, by a lateral sawing motion, the grafts are cut as broad and as long as possible. After a little practice it is easy to cut grafts about two inches in breadth and six or seven inches in length. If one graft is not sufficient, it is best simply to slide it off the razor and leave it lying on the bleeding surface; in this way it is kept warm and moist. Some surgeons put the graft into warm normal salt solution or saturated boric acid lotion, and it is then said to spread out more easily afterward, but by the former plan the tissues lie in their own juices and the cells are more likely to retain their full activity.

Application of Grafts.—When a sufficient number of grafts have been cut, the bandage, sponges, and protective are removed from the wound, and if bleeding has quite stopped, as is generally the case, the grafts are applied to its surface. The latter usually has a thin layer of blood-clot upon it, and this should be gently wiped away. Each graft is lifted with forceps or the fingers, and placed on the sore with the cut surfaces downward, and then, by means of a couple of probes, the folds of the graft are carefully undone, and it is stretched evenly over the surface. The grafts should overlap the edges of the skin and also each other, so that no part of the raw surface is left exposed, for granulations always spring up on the uncovered parts, and are apt to eat away the grafts in their vicinity; furthermore, a thin scar, which may subsequently break down, is left at these points. The graft is always thinner at the edge than at the center, and it is these thin edges which overlap each other or the edge of the ulcer; there is no real sloughing of these overlapping edges.

Dressings.—In spreading out the graft it will be found that air-bubbles collect beneath it, and also that some amount of oozing goes on, and the bubbles and clot may prevent complete adhesion of the graft.

Hence the next procedure is to get rid of them by pressure. If that is attempted by means of sponges or the hands, the graft is apt to be displaced. The following is the best plan: Strips of protective about an inch in breadth, and long enough to overlap the edges of the wound, purified in 1:20 carbolic lotion and subsequently rinsed in boric acid lotion, are applied firmly over the grafted surface, beginning at the lower part. Each strip should overlap the one below, just as in the case of strapping, and they should extend well on to the skin at each end. If each strip as it is put on is grasped by the two ends and firmly pressed down on the limb, the pressure thus applied suffices both to expel the air-bubbles and blood, and also to arrest further capillary oozing. The whole surface of the skin-grafts being thus covered, ordinary sterile gauze wrung out of 1:6000 mercuric chlorid solution is applied, with salicylic wool outside it. The limb should afterward be placed upon a splint, or at any rate fixed that movement cannot occur during the progress of healing.

The place from which the grafts have been taken may also be dressed with the protective and gauze dressing, which need not be disturbed for ten days or a fortnight. At the end of that time the whole surface will usually be healed, unless the razor has somewhere gone a little deeper than is necessary. If healing is not quite complete, weak boric ointment may be applied. The limb from which the grafts are taken should always, if possible, be the same as that on which is the ulcer requiring grafting; for example, when the ulcer is on the leg, the grafts should be taken from the thigh of the same side. Unless this is done, a second splint will be required to fix the limb from which the grafts have been taken until healing is complete.

Changing First Dressing.—The dressing should be left on the grafted surface for about five days; in some cases it may even be left for a week. If the wound is aseptic, no suppuration or decomposition takes place beneath it. While removing the dressing, it should be thoroughly soaked with a 1:2000 mercuric chlorid solution, for the protective may stick at the edge and adhere to a graft, which may thus be peeled off unless great care is taken. The parts should be gently cleansed with a 1:2000 mercuric chlorid solution, and it is best to re-apply the protective and gauze dressing for about another week. At the end of that time the grafts are fairly firmly adherent, and then a mild antiseptic dressing should be applied.

After-treatment.—It will be found that, even at the first dressing

the grafts present a pink color and are adherent to the deeper surface, though they are still readily detached. In the course of about a week the old epidermis peels off, but no raw surface is left. Later on there is a great tendency to the formation of new epithelium, cornifications, and drying up, and it is in avoiding the latter condition that ointments are so useful. In fact, till the scar is absolutely sound it is well to keep the surface covered with oily application, the best being sterilized cosmolin. (Cheyne, "Manual of Surgical Treatment," Lea Bros. & Co.)

Transplantation in mass is a method not elaborated upon by Cheyne, and it appears to have been first used by Wolfe, of Glasgow, and later revived by Krause. It consists in removing the entire thickness of the skin at a point distant from the granulating surface to be covered. The area of the skin-mass must be from one-sixth to one-third larger than the granulating surface to be covered, must have been shaved and thoroughly disinfected before removal, and contain no particles of subcutaneous fat. Sutures are not employed, and the after-treatment is practically the same as in the Thiersch method, except that should blebs form on the transplanted skin they are to be opened. Cicatricial contraction is not marked after the transplantation method, but the fact that it involves a more formidable operation and leaves a large granulating wound where the skin was removed detracts from its value as compared with other methods.

A. B. Craig, of Philadelphia, has shown ("American Medicine") the value of Cargile membrane in skin-grafting, particularly by the Reverdin method. He applies the grafts in the ordinary manner, and covers the entire field with a sheet of Cargile membrane. Dry sterile dressings are placed over this and a firm bandage applied. If the granulating surface is old and the skin-edges thickened, strapping is resorted to, the adhesive strips being applied over the sterile dressings, and a bandage covers the whole. In any event the dressing is carefully removed within forty-eight hours, when it will be found that the Cargile membrane is largely digested. The advantage ascribed to the use of the membrane is that it not only appears to stimulate epithelial growth, but it protects the delicate grafts for a number of hours, and is gradually digested by the granulations, thus permitting the wound secretions to escape into the dressings. This method can be readily carried out on ambulatory patients in dispensary service, as well as within the hospital wards.

CHAPTER VIII.

OPERATIONS.

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Remarks.—The consideration of the after-treatment of all operations would require much repetition, and occupy far more space than can be given in this work. I have therefore decided to describe only those operations which are classed as general surgery, making no attempt to invade the field of the specialist.

Postoperative Treatment of Operations Upon the Scalp, Removal of Sebaceous Tumors, Wens, etc.—In operations upon the scalp, removal of sebaceous tumors, wens, etc., drainage is imperative. A small piece of gauze should be inserted at the most dependent portion of the incision, and removed on the third or fourth day. The rest of the wound may be united and permitted to heal as rapidly as possible. Scalp incisions, as a rule, heal rapidly, and owing to the abundant blood-supply, sepsis rarely follows. Strict adherence to asepsis and the removal of hair well from the field of operation render the after-treatment much easier. Dressings should be changed as often as required, and firm bandages applied.

OPERATIONS UPON THE SKULL AND BRAIN.

General Remarks.—After operations upon the skull or brain the patient must be kept quiet in a darkened room. Careful avoidance of all excitement and absolute isolation are imperative. The bowels should be kept open; the use of alcohol or other stimulants is contraindicated. After trephining, the wound is usually treated after the open method, *i. e.*, gently packed with aseptic gauze and a compress and bandages applied. Should inflammation occur, it is usually manifest about three or four days after the operation. Rise of temperature and other symptoms of infection call for immediate change of dressing and careful irrigation of the wound. If this treatment does not suffice and there are indications of further and deeper-seated infection, or if abscess of the brain occurs, as manifested by nausea, vomiting, irregular pulse, and irregular chills, with pain in the head (not necessarily in the wound) increased by per-

cussion, and especially if there is a tendency to hebetude, normal or *subnormal* temperature, disinclination to make effort, and stupor, an effort should be made to locate the abscess and evacuate the pus. The abscess cavity should be thoroughly cleansed with sterile salt solution and drained by gauze or tube.

Complications Following Operations on Brain.—Secondary Meningitis.—Secondary meningitis by extension of the septic condition from the seat of operation sometimes occurs, indicating during convalescence a failure to keep the wound clean. Veins or lymphatics may carry an infected clot to the meninges, or the infection may be carried by direct continuity of tissue. A meningitis following an operation upon the skull or brain will be most pronounced in the vicinity of the incision, but when once inflammation arises, there will be cloudy or purulent cerebrospinal fluid, with exudation. Constitutional sepsis is a rapid sequel of meningitis in most cases. It may extend not only to the base of the brain, but to the spinal meninges. The ordinary clinical symptoms of weak rapid pulse, elevated and variable temperature, delirium, hyperesthesia of the surface, restlessness, retained urine, constipation, intense headache, glistening eyes, trembling and busy hands, followed by stupor, hebetude, contracted pupils, which often do not react to light, make up a picture which admits of little doubt. Should meningitis be more pronounced along the fissure of Rolando, local spasms or paralyses are to be expected. The results of treatment are not favorable. Attention to the secretions, rest, removal of all exciting causes, the application of an ice-bag to the head, cool sponging if the temperature is high, strychnin to support the pulse, will probably be all that is to be done. The free opening of the wound and an attempt to obtain drainage are often followed by good results. It is frequently impossible to arrest the inflammation, but this much is certain, that when inflammation occurs in a closed cavity, it is always important to have the cavity opened, so that the products of inflammation may find an exit and tension be relieved. After trephining, in case a fissure-fracture has traveled to the base of the skull, basilar meningitis is very likely to follow, and, since many important cranial nerves are given off from this part of the brain, a disturbance of their functions will be noted. However, the inflammation is rarely limited to the base of the skull, but extends to the upper part of the spinal meninges and so retraction of the head and interference with, and disturbance of, the upper spinal muscles are likely.

When there has been any evidence of extension of the inflammation to

the spinal meninges, spinal puncture or laminectomy may be resorted to, with irrigation; but the results, up to the present, of either of these procedures do not warrant great hopes of recovery. (Abstract from Warren-Gould.)

Postoperative Hernia Cerebri.—Postoperative hernia cerebri is an evidence of sepsis, local perhaps. The protruding mass, which is brain-substance, at first is small; but subsequently may become large, may slough, may suppurate, but always projects above the level of the skull. It will pulsate and is soft to the touch—not vascular, however; it is possible to cut away portions of the hernia, for brain-substance is insensitive. When portions of the hernia are cut away, new portions are apt to protrude through the skull. As inflammation diminishes, the hernia will sink within the head and cicatrization take place, or the patient may die of general sepsis.

Treatment.—An attempt to force the brain back into the skull will give rise to symptoms of compression not advantageous to the patient. Cutting off pieces of the brain down to the level of the skull is not called for. A clean dressing, with a light compressing bandage to hold the dressings in place, and so exercise a very slight pressure on the hernia, is all that is necessary. The surface of the hernia may slough, and if so, the dressing should be changed and cleanliness continued. As the wound becomes clean and cicatrization takes place, the hernia will disappear. (Warren-Gould.)

Fig. 31.—Hernia Cerebri.—(*Bryant.*)

Trephining.—Closure of the Wound.—The flap of dura is brought into place, and is secured to the unwounded part of the membrane by a few fine catgut sutures; space, however, must be left for drainage. The trephine disc or any large fragment of bone which has been preserved may be replaced as nearly as possible *in situ*. In case the bone is not replaced, as it is in the osteoplastic flap of Wagner, and it is desired that the bony skull-wall shall be restored, Keen, in clean cases, preserves, in warm salt solution, the bits of bone removed by the rongeur forceps, and when the dura is closed he "sows" these frag-

ments on the dura, like a thin layer of gravel, and then closes the scalp over this. This brings about restitution of the bony wall. The replacing of the trephine disc or of large fragments of bone is not necessary, and should be resorted to only when the portion removed is very large and when the scalp at the time of the operation is intact. Such replacing of portions of bone should not be practised in cases of compound fracture, as infection is more than probable.

The flap or flaps of scalp are now brought into place by silkworm-gut sutures, and drainage is secured by introducing a bunch of horsehair threads here and there between the stitches or by a slight gauze drain. The skin is well cleansed, the wound is dusted with iodoform, and a suitable dry dressing is applied and is secured by means of a tight flannel bandage.

After-treatment of Cases of Trephining.—The patient is kept absolutely at rest, and the room occupied should be perfectly quiet. The head is kept a little raised. The wound is dressed upon ordinary surgical principles. In case of fracture, or in case of trephining for epilepsy, etc., in which no lesion of the dura exists, draining by catgut will suffice. In cases of trephining for the removal of a brain tumor, or the evacuation of a cerebral abscess, drainage with a tube is necessary. In the former case the tube is retained for twenty-four hours only; in the latter it is retained until the abscess cavity has practically closed, and is shortened as often as required. In a few instances of intracranial suppuration a second opening in the skull may be necessary to insure perfect drainage.

If, after the removal of the drainage-tube in any case pain and throbbing in the wound are complained of, and if the scalp flap appears to be raised up, it may be necessary to reopen the track of the drainage-tube to allow pent-up discharges to escape. Sutures may be removed at any time after the fifth or sixth day, or be retained as long as appears needful. If a hernia cerebri form, it can best be treated, so far as my own experience goes, by means of a pad of gauze and wool, kept constantly wet with absolute alcohol. The surface of the protrusion hardens and forms a species of scab or cuticle, which in time becomes quite tough, and affords an efficient covering to the exposed brain. (See Hernia Cerebri.) The patient will need to remain in bed until the wound is soundly healed. From two to three weeks will represent an average time. The diet is such as is advised after any grave operation.

Secondary or Postoperative Hemorrhage.—Hemorrhage from the brain tissue is seldom troublesome. The arterioles for the most part

run perpendicularly to the cerebral surface. Most of the bleeding is soon checked with sponge pressure, with ice, or by the use of sterilized adrenalin solution. The actual cautery should never be employed to arrest bleeding from the brain. Extensive divisions of surface blood-vessels may be avoided by lifting them out of the sulci between the convolutions, and replacing the pia after the operation.

The treatment of bleeding from the venous sinuses is best controlled by pressure.

Postoperative Adhesions in Brain Surgery.—Method of Preventing.—One of the most troublesome complications following operations on the brain, especially for the relief of epilepsy, is the post-

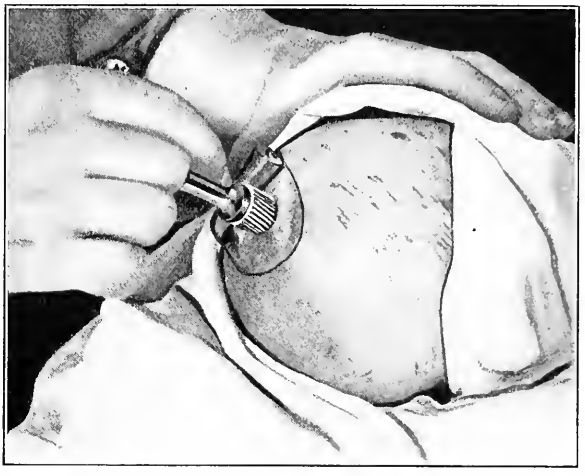

Fig. 32.—Resection of Skull.—(*Binnie.*)

operative formation of adhesions, involving the cortex of the brain and its covering membranes. The adhesions occur most frequently between the dura and pia or between the pia and brain-substance, and forming thus mar the success of the most brilliant operations. Many devices have been used to prevent the formation of adhesions; of these, gold-foil, rubber tissue, gold-beater's skin (Outten), and other like substances have been used with variable success. Thin metal plates of gold and of silver were popular for a time, but are now discarded. In a recent issue of the "Journal of the American Medical Association," M. L. Harris, of Chicago, suggests the use of silver-foil. He writes as follows:

"The best material to be used and the details of technic, however, are questions still to be worked out. There are some points which appear

to be well established. For instance, the traumatism incident to the operation should be as slight as possible. A bone flap which can be replaced is preferable, when possible, to the trephine opening with the bone left out. Before the introduction of any substance hemorrhage should be perfectly controlled and all blood-clots removed. The substance should extend well beyond the edge of the area involved in the adhesions. There should be no openings or breaks in the substance. The material must be one which can be sterilized. The wound must heal in a perfectly aseptic manner. The question of material is not so well settled. Whether the organic substances, such as egg-membrane, prepared ox peritoneum, etc., will prove of value remains to be determined. They

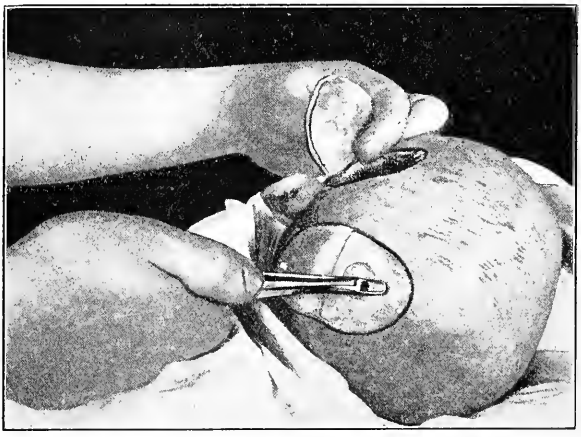

Fig. 33.—Use of Bone Gouging or Cutting Forceps After Trephining.—(*Binnie.*)

have not been used often enough to relieve one of the theoretic doubt of their efficacy. Thin rubber tissue has been used a number of times with good results. The author has a patient who has carried a good-sized piece of rubber tissue in his skull for several months with an excellent result. One disadvantage of the rubber is its tendency to roll up after it has been inserted. It then not only fails to fulfil its purpose, but may be an actual cause of irritation. The author knows of one unreported case in which the rubber, which had to be removed some months after it was introduced, was found rolled up. The rubber may also be disintegrated by granulations.

"Of the materials thus far proposed, the author believes the thin foils are the best, and of these he prefers the silver-foil. It is thin and soft and

smooth. It conforms to all irregularities of the surface on which it is laid. As many layers may be applied as may be necessary to secure a smooth, unbroken surface. It is not only tolerated kindly by the tissues but exerts a beneficial influence on granulating or healing surfaces. The foil may be placed directly in contact with the brain-tissue, between the pia and dura, or wherever it may be necessary to accomplish the purpose desired.

OPERATIONS UPON THE JAW.

Excision of the Superior Maxilla.—After removal of the bone it is essential that all hemorrhage be checked, and the periosteal flaps from the roof of the mouth and front of the bone be carefully sutured together, preferably with chromicized catgut, and before the completion of any form of resection, either of the upper or lower jaw, the buccal mucous membrane should be accurately adjusted if divided, and deeper sutures should be carefully placed. If the nasal cavity is opened, the soft tissues should also be carefully closed by sutures. In resections of the lower jaw when the attachments of the geniohyoglossus muscles are divided and the tongue tends to fall backward upon the glottis, the tongue and muscles should be drawn forward and the severed attachments sutured as far forward as possible to the buccal and deeper tissues, after which the wound should be packed with gauze and drained from the outside. This drainage may be removed so soon as it loosens—usually the third or fourth day.

After-treatment.—The patient should be well sustained by careful liquid nourishment for the first forty-eight hours, if necessary, by means of a short esophageal tube. Morphin should be administered hypodermatically if required. The gauze plug should not be large enough to bulge the cheek and cause a strain upon the sutures. It should be removed in twenty-four hours, as it soon becomes offensive if retained. Every possible care should be taken that the mouth and the wound cavity are kept clean. The patient should be raised up in bed by means of a bed-rest, so as to facilitate the escape of discharges. He should rinse the mouth very frequently with some antiseptic solution. Carbolic acid (1 in 60 or 80) answers admirably. Two or three times a day also the cavity should be well washed out with a like solution from an irrigator provided with a wide-mouthed nozle. The surface wound should be kept dry, and dusted with iodoform. The feeding of the

patient is a matter of the greatest importance. He may be fed for the first day or two with the esophageal tube. Through this tube milk, beaten-up eggs, beef-tea, and brandy can be administered as frequently as desired.

If necessary, this mode of taking nourishment may be supplemented by nutrient enemas. So soon as the patient can swallow food without assistance the mouth must be washed out each time after food is taken. The skin-wound generally heals well, and if no complications arise the patient may be up in a week or ten days. When the wound is quite

FIG. 34.—RESECTION OF THE LOWER JAW.—(*Dennis.*)

sound, the question of fitting an artificial palate or tooth-plate has to be considered.

Excision of the Lower Jaw.—AFTER-TREATMENT.—The general features of the after-treatment have been alluded to in dealing with the upper jaw. The main difficulty is to keep the mouth sweet. A large pouch is left in the floor of the mouth, and in this food and the secretions of the mouth must of necessity collect, and here they are apt to decompose. If care is not taken, this pouch becomes the seat of the foulest possible sloughs. It is difficult for the patient to wash the mouth out efficiently, as it is painful to move the remaining portion of the jaw, or even to

move the head. The best wash is a 1 percent or 2 percent solution of carbolic acid.

The cleansing of the mouth is best effected by irrigation. For the first few days—if possible, for the first ten days—it will be well if the food can be administered through a tube, so that none can find its way into the mouth. If this is done, and if the mouth is washed out every hour with a gentle stream from an irrigator, the parts can be kept in excellent condition, and healing will proceed rapidly. If a drainage-tube is employed, it should be removed in twenty-four hours, and the escape of the fluids in the mouth through the skin-wound should not be encouraged after that time.

The patient should occupy the sitting position as much as possible and every care should be taken that he is well fed. In the manner of feeding I have usually employed the nasal tube, which has been passed after a little cocain had been introduced into the nose through an atomizer. The foulness of the mouth in a neglected case is indescribable, and the persistent attempt to avert decomposition is a main element in the after-treatment. (Treves.)

After partial resection of the lower jaw, a carefully padded and adjusted splint should be applied to prevent movements of the part and keep the lower jaw in proper relation to the upper. In section of the ramus for ankylosis passive motion should begin the third or fourth day after the operation, and be regularly maintained. It is usually necessary to use anesthesia for this purpose. Relapse is very likely to recur, however, unless the proper after-treatment is carefully carried out.

EXCISION OF THE TONGUE.

General Considerations. — Whether the operative method of Whitehead or of Kocher—those most commonly employed—be followed, after-treatment is very essential.

Prior to the operation it is essential to have the teeth, mouth, and pharynx thoroughly cleansed by scraping away all tartar, by drawing all bad teeth, and by cauterizing all ulcerating patches. Small abscesses and collections of decomposing matter in the crypts of the tonsils should be disinfected after carefully slitting up their cavities. The avoidance of injury in any manner to the mechanism of swallowing is also very important; *i. e.*, the muscles of the floor of the mouth, tongue, and pharynx, with their nerves of supply. Further, free escape must be

given for the discharge and secretions from the mouth. It is only by careful attention to these points that the danger from decomposition of the exudation from the wound can be reduced to the minimum. It is likewise essential that the patient be placed, so soon as recovered from the anesthesia, in a half-sitting position, and so soon as possible he should assume the sitting posture or be gotten out of bed. The method which Kocher now employs, and which is described in a recent (1903) edition of his "Text-Book of Operative Surgery," is a modification and

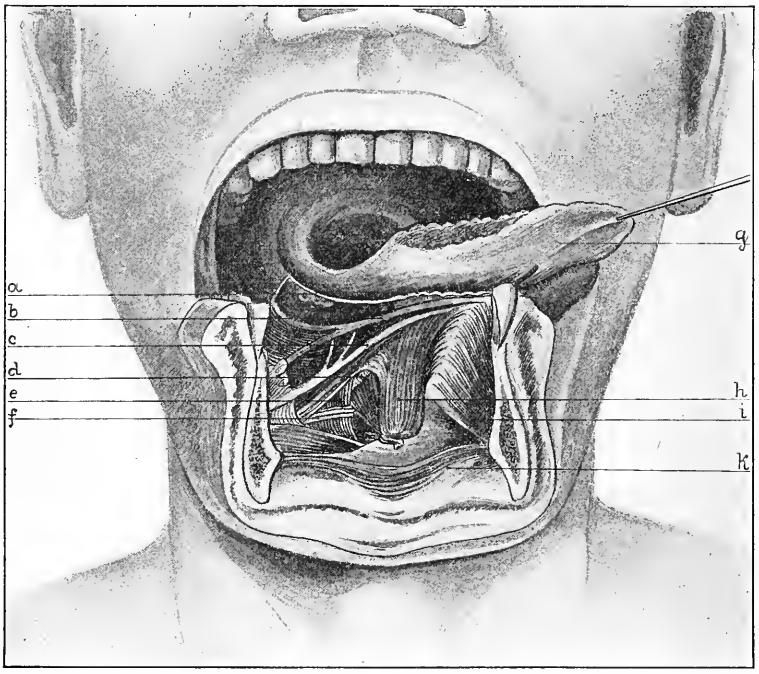

FIG. 35.—ANATOMIC RELATIONS OF THE PARTS INVOLVED IN KOCHER'S PRESENT OPERATION FOR REMOVAL OF THE TONGUE BY MEDIAN DIVISION OF THE LOWER JAW. —(*Kocher, "American Text-Book of Surgery."*)

a, Line of division of the mucous membrane; *b*, lingual nerve; *c*, lingual vein; *d*, lingual artery; *e*, hyoglossus muscle; *f*, hypoglossal nerve; *g*, tongue; *h*, right geniohyoglossus muscle; *i*, left geniohyoglossus muscle; *k*, geniohyoid muscle.

extension of the Sédillot-Syme operation, in which the lower lip is divided vertically and the symphysis menti is sawed through, permitting free access to the floor of the mouth. Kocher divides the soft tissue backward to the hyoid bone. All vessels are ligated as they are severed

during operation. The wound is closed by wiring the divided bone and suturing the soft parts anteriorly, but an important point is that thorough drainage is secured through the floor of the mouth, the gauze being carried through the skin-incision near the hyoid bone. The method of Kocher has the following advantages: the postoperative hemorrhage is very slight or more easily controlled, the secretions of the wound are drained away much more satisfactorily, and preservation of the tissues of deglutition along with their nerves, by which a better functional result is obtained than by any other method. (This preservation of the powers of deglutition is of the greatest importance in preventing secondary pneumonia, the great danger which threatens the patient.)

Method of After-treatment by Sir Frederick Treves.—"The patient may be allowed up on the third or fourth day, and in the majority of the cases I have treated at the London Hospital the patient has left the hospital between the seventh and the tenth day after the excision.

"I have been very much disappointed with a solution of potash permanganate as a wash, and have long since given it up. Boric lotion is still more ineffective.

"Some surgeons, notably Wölfler, have advised that the floor of the mouth be packed with iodoform gauze. I have tried this dressing, but cannot recommend it. Mr. Whitehead does not encourage his patients to consider themselves invalids. They get up on the day after the operation, and may on that day take open-air exercise. Food is administered by the mouth on the day after the excision. In the matter of rapidity of recovery, Mr. Whitehead's cases stand preëminent.

"Many American surgeons prefer to pack the floor of the mouth with iodoform gauze in long strips which come out through the lower or counteropening, or through the most dependent portion of the external wound, which is partly closed, covered with iodoform gauze, and firmly bandaged. By far the best and simplest method, however, is to place a soft-rubber drainage-tube well into the floor of the mouth and have it pass out the external cut or wound at the lowest possible point. The tube should pass through the outer dressings of iodoform which are protected from saturation by rubber tissue. Over the outer opening of the drain tube is placed a layer of absorbent cotton, and over this a second or temporary bandage. The first or primary bandage, if applied tightly, adds much to the comfort of the patient and facilitates swallowing. The drainage-tube helps materially to keep the surface inside the

mouth dry and clean. The mouth should be thoroughly irrigated with hot normal salt solution several times a day, and the external or temporary dressings should be changed as frequently as necessity may require. The after-treatment in all these cases or methods of operating involves three great factors: First, the patient must be *well fed;* second, *thorough drainage* must be established from the mouth; third, the cavity of the mouth must be kept *clean* and sweet."

Method of After-treatment by Kocher.—"Some surgeons simply dust the floor of the mouth with iodoform. Others resort to the objectionable practice of stuffing the mouth, or at least the lower segment of it, with gauze. I have dispensed with applications of any kind. The mouth is well washed out with an antiseptic lotion and is left. It must be remembered that the discharge of saliva is fairly copious, and renders any 'dressing' almost immediately ineffective.

"The patient is encouraged to sit up in bed as soon as possible. Morphin should be avoided whenever it can be; it dulls the reflex sensibility of the patient, and may cause him to allow fluid to run down into the air-passages.

"The patient must be impressed with the importance of allowing all discharge to escape from the mouth, and of swallowing none of it. The mouth must be kept constantly washed out. This rinsing of the mouth cannot be too frequently performed. Every half-hour in the day, and three or four times in the night, is not too often. The best wash is carbolic lotion (1 in 60 to 1 in 80).

"After certain of the washings, say, three or four times a day, the floor of the mouth is dried with a pledget of cotton-wool, and iodoform is dusted over the raw surface. It soon forms a more or less consistent pellicle over the stump. A watch must be kept for the symptoms of iodoform poisoning. During the first twenty-four hours the patient may be fed by the rectum, and ice only should be taken by the mouth. The use of ice should be very moderate, as it does little but fill the mouth with fluid, which gives the patient some trouble to get rid of. At the end of twenty-four hours the patient should swallow food. It is best given with an ordinary feeder, while the man sits upright, with his head inclined to one side.

"The difficulty of swallowing is usually overcome with a little patience and practice. Should the patient be quite unable to swallow, then he must be fed with an esophageal tube. One feature in the after-treatment of these cases must not be lost sight of. The patient

must be *well fed.* As soon as enough nourishment is taken by the mouth the nutrient enemas may be discontinued. After every occasion upon which food is taken, the mouth must be well washed out.

"Now and then the cavity may be flushed out with an irrigator. These cases demand the undivided attention of two nurses, one for day and one for night duty, for upon the careful nursing of the case as much of the success depends as upon the operation.

"No drainage of the mouth cavity is needed in these cases. If the part becomes unduly offensive, a stronger solution of carbolic acid must be used, and the mere rinsing out of the mouth must be replaced by a flushing out of the cavity with the irrigator.

"These perpetual washings-out of the mouth involve considerable annoyance to the patient, but they are necessary only for a few days, and it must be borne in mind that the usual cause of death after these operations is septic pneumonia."

CLEFT PALATE.

After-treatment (Cheyne).—The patient is placed in bed with the head low and turned to one side so that the blood may trickle out through the mouth. There is often a good deal of shock, and the patient should be surrounded with hot bottles or be put upon a large hot-water pillow. Food should not be given until all danger of vomiting has ceased, and for the first four or five days nothing but liquids should be taken; during the first forty-eight hours these are best given iced. The food should consist of milk, milk and soda, or milk and lime-water. It is best given with a spoon, and later on from a feeder furnished with an india-rubber tube which is passed as far back as possible at the side of the mouth. After the fourth day bread and milk, custards, arrow-root, etc., may be given, but no solid food should be administered for at least ten days.

The most important part of the treatment consists in keeping the patient absolutely quiet. Talking, laughing, crying, etc., must be guarded against as effectually as possible. The hands should be muffled if necessary and tied to the side to prevent the risk of the child sucking the thumb or fingers; or an effectual plan, and one that is less irksome to the child, is to mold small splints of cardboard or felt along the front of the arm from the middle of the upper arm to the middle of the forearm. This prevents the child flexing the elbow; he therefore cannot reach his mouth, but he can use his arms and can play with his toys, etc.

At the end of that time the palate should be examined and the stitches removed, at any rate from the hard palate; in order to do this satisfactorily it is well to administer an anesthetic. Should the union be good, all the stitches may be taken out then; if at any part the union is doubtful, they should be left in for a few days longer.

Complications.—There are two probable complications common to all operations for cleft palate:

1. Bleeding.—As a rule, the hemorrhage, though free at first, is easily controlled by gentle sponge pressure. If it is obstinate, it generally results from incomplete division of the posterior palatine artery or some of its branches. Secondary hemorrhage may also occur and is fairly common in weak, anemic children or in those who are the subject of hemophilia.

Treatment.—This is comparatively simple. If the hemorrhage is troublesome at the time of the operation and sponge pressure will not stop it, the clots should be carefully wiped from the region of the lateral incisions and the source of hemorrhage exposed. If it comes from a partially divided vessel at the end of the incision, the extension of the incision will probably suffice, especially if combined with firm pressure directly upon the bleeding point either with the finger or a small piece of sponge. The treatment of secondary hemorrhage is sometimes more difficult. In the first place, an attempt should be made to check the bleeding by syringing away the clots with iced boric lotion, and small pieces of ice inclosed in muslin may be pressed against the lateral incision from which the bleeding is coming. If this fails, an anesthetic should be given, and, after the blood-clot has been cleared away, the bleeding point should be exposed. If firm pressure on it is not effectual, and if the vessel cannot be picked up in forceps and tied, the bleeding will probably be coming from the posterior palatine canal, and an attempt should be made to stop it by temporarily plugging the canal with a fine probe. If this does not succeed, the canal may be plugged with Horsley's wax (see page 40).

2. Failure of Union.—The other important complication is failure of union at some part of the cleft. The failure may be partial or entire. It generally happens that only one portion gives way, and it is most common to find a deficiency either at the extreme anterior end or about the junction of the hard with the soft palate. Nonunion may be due to one of three principal causes:

(*a*) *Imperfect Operation.*—The cleft may be insufficiently pared,

generally because each side has not been pared in a single piece and thus some part has been overlooked or only a very narrow portion removed; the tension upon the flaps may be so great as to interfere with union; the flaps may be brought badly into apposition, one edge being curled up so that the raw surfaces are not together; the stitches may be tied either too loosely or too tightly; or the flap may be so bruised by rough handling that its vitality is seriously diminished.

(*b*) *Intercurrent inflammatory affections*, such as a severe cold, the onset of a specific fever, or ordinary septic infection, may entirely prevent union. Septic infection of the line of incision is largely predisposed by rough handling of the flaps.

(*c*) *Want of proper care in the after-treatment* may bring about failure of union. Among the most important factors leading to failure of union after an otherwise perfectly satisfactory operation are excessive crying, vomiting, or mechanical violence produced by hard food, fingers, or foreign bodies thrust against the flaps.

It is well to remember that, unless union fails throughout the whole palate, the gap left after limited failure of union is diminished very considerably in the course of time by the granulations springing up around the hole. This is especially the case in the soft palate.

Treatment.—The treatment in cases in which union seems doubtful is, of course, largely prophylactic, and every precaution must be taken in the way of careful operation and after-treatment to see that nothing interferes with union. Any intercurrent affection, such as a cold, should receive careful attention. If, when the wound is examined, there be any doubt as to the amount of union present, the stitches should not be removed for a fortnight or three weeks. Should failure of union occur at any part, it is well to wait until the edges are freely granulating, and then, after administering an anesthetic, to introduce fresh sutures and draw the flaps together without tension. It is not generally necessary actually to pare the edges when introducing stitches for the second time, although it may be advisable to scrape the granulating edges slightly. These second stitches should be left in for at least a fortnight. If this secondary union fails, it is well to delay further operative interference for a period of at least six months, so as to allow complete cicatrization and contraction to take place. The subsequent operation consists in paring the edges of the defect, making lateral incisions for the relief of tension, and then bringing the edges together. Unfortunately, if the union fails in the soft palate, the contraction leads to shortening of the palate, so that sec-

ondary operations seldom avail to bring about a perfect result. Hence every possible care should be taken to secure union in the first operation.

After-treatment (Treves).—The patient should remain in bed for a week. No food of any kind should be administered until all vomiting has ceased. The diet should be simple, and may consist for the first day of milk or milk and water only, and after that of beef-tea, broth, eggs, arrowroot, custard, and sago puddings, bread and milk, stewed fruit, and the like. Porridge, pounded meat, or fish may be given when a few days have elapsed. Two mistakes are frequently made in the after-treatment: one is to starve the patient, and the other is to feed him

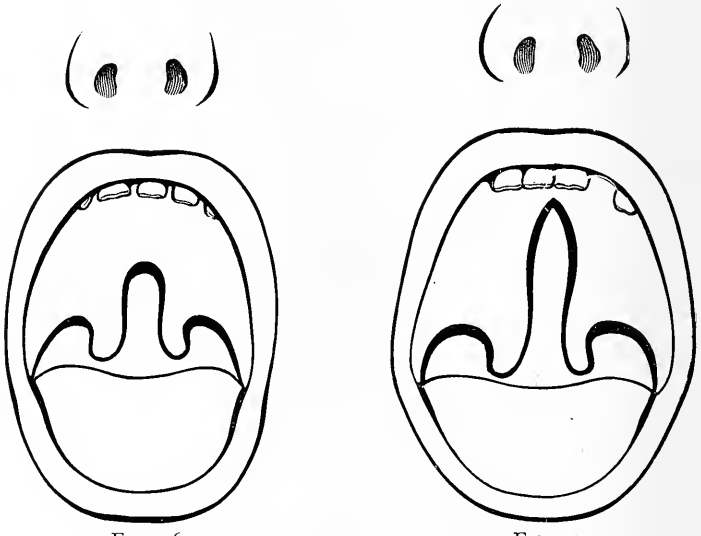

FIG. 36. FIG. 37.

TYPES OF CLEFT PALATE.—(*Brewer.*)

so frequently with small quantities of food that the pharyngeal muscles are never at rest. One author, indeed, says that food should be administered "unceasingly."

The patient should be fed as an ordinary patient is fed, but the food must be fluid, or at least perfectly soft, and must be swallowed slowly and carefully. The pharyngeal muscles contract more completely around a small bolus than a large. This simple and almost fluid diet should be observed for two or three weeks, until, indeed, it is clear that the wound has healed or has broken down hopelessly. It is well to forbid much talking. For the first few days the less the patient speaks, the better.

One important factor must not be overlooked—the mouth must be kept clean. It is often rendered foul by decomposing milk and beef-tea, which remain in the recesses of the mouth, owing to the patient's exaggerated belief in the evils which attend swallowing. The best wash is a warm solution of carbolic acid (1 in 100 to 1 in 80). Boric-acid lotion also answers well.

The mouth should be rinsed out after every meal, and at other times as occasion suggests. I am in the habit of having the wound washed at least twice a day with a warm boric-acid solution, which is applied to the palate by means of a "scent spray." It is agreeable to the patient, and it keeps the part free from incrustation.

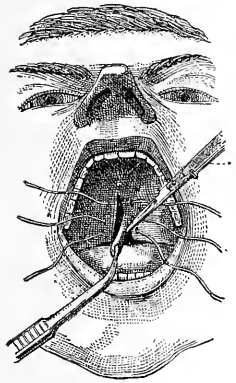

FIG. 38.

The edges of the cleft are being pared with a probe-pointed bistoury after passing the sutures. It is better to pare the edges before passing the sutures.—*Bernard and Huette.*)

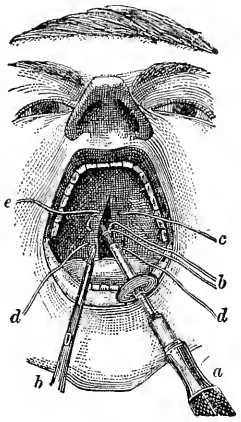

FIG. 39.

Method of Rink: The sutures *d d* and *c c* in place, the third, *b*, being inserted from behind forward by a curved needle-holder, *a;* the lips are held tense with the forceps. —(*Bernard and Huette.*)

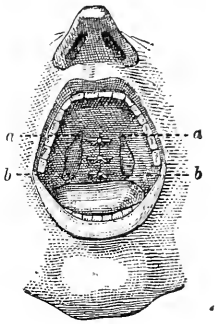

FIG. 40.

The sutures being fastened, the lateral incisions *a b* are made to relieve tension by division of the tensor palati muscles.—(*Bernard and Huette.*)

The advice that the palate in young children should not be inspected for one week after the operation is hardly consistent with the practice which obtains in the treatment of wounds elsewhere.

The sutures need not be removed until fourteen days or three weeks have elapsed. Sutures of silkworm-gut and fine silver set up singularly little disturbance, and may be retained for weeks, but it is obvious that if firm union has not taken place in three weeks, it will probably not take place in five.

Results.—The success of the operation may be compromised by

severe vomiting, by the swallowing of solid food, by the development of whooping-cough or an eruptive fever, or by the feebleness of the patient's health. It must be remembered that the closure of the cleft does not remedy the defective articulation. The soft palate in these cases of congenital deformity is not only deficient in the median line, but deficient, as a rule, throughout. It is unduly short, and after the most successful

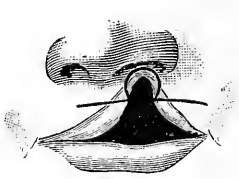

FIG. 41.

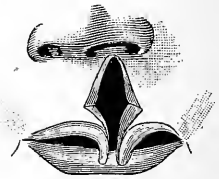

FIG. 42.

(MALGAIGNE.—*Binnie, after Esmarch and Kowalzig.*)

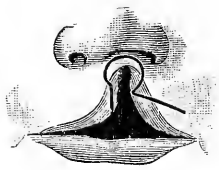

FIG. 43.

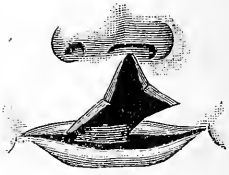

FIG. 44.

NÉLATON.—(*Binnie, after Esmarch and Kowalzig.*)

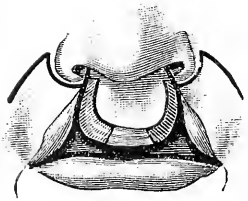

FIG. 45.

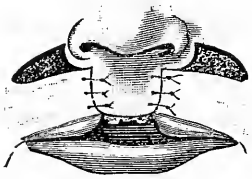

FIG. 46.

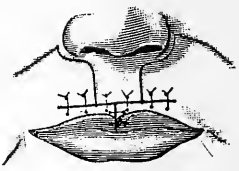

FIG. 47.

(*Binnie, after Esmarch and Kowalzig.*)

operation it is doubtful if the palate is ever so completely restored that it is capable of shutting off the mouth from the nasal passage.

The operation, however, places the patient in a position to attain normal articulation. It enables him to be educated to speak naturally. This education is tedious, and involves a great expenditure of time and trouble, but it is remarkable what excellent results may follow, even in

cases which cannot be considered from a surgical point of view to be eminently successful.

HARE-LIP.

Operations Upon Infants.—So soon as the bleeding has stopped, the line of incision is painted with collodion and the following method, introduced by Lord Lister, is of value as a support to the wound: A double thickness of gauze is cut in the shape of a bat's wing, one broad surface lying over each cheek and the narrow intervening portion passing across the lip. One end of this dressing is then fastened to the cheek with collodion, and, when it is dry, the two cheeks are pushed forward and held in this position while the other end is fixed with collodion to the other cheek and held in position until it is quite dry; in this way all tension is avoided. If the nostril is unduly small after the stitches are put in, it is well to put a small drainage-tube in it to leave breathing space; fatal cases are recorded from the valve-like action of the upper lip combined with the blocking of the nostrils by clot obstructing the breathing. In time the nostrils will become quite patent. (Treves.)

After-treatment.—The stitches can usually be removed at the end of a week; in fact, the horsehair and catgut sutures may be removed in two or three days, the deeper silkworm-gut stitches being left for a week or more. After the operation the child should be entirely fed by the spoon with very great care to prevent injury to the line of incision; the point of the spoon should be introduced at the side opposite to that operated on. After the wound has healed, the patient may be put on the bottle.

OPERATIONS ON THE NOSE.

Subcutaneous Paraffin Injection.—(Abstract from "Progressive Medicine," March, 1904.)

The secret of the postoperative success or failure of the operation depends largely upon the kind of paraffin used and the aseptic technic of the procedure. Perusal of the various writings upon this subject shows clearly that paraffins having different melting-points have been employed; thus, Gersuny himself used white vaselin or the unguentum paraffin, a mixture of solid and liquid paraffin, a substance having a melting-point of 97° to 104° F. Objection has been raised to the employment of this form of paraffin on the ground that it remained liquid

for some hours after its injection into the tissues, and therefore favored embolism, also that infiltration into the neighboring tissues is possible after its introduction. It has also been asserted that a slow absorption of this material is possible, and that consequently permanent improvement was not to be expected from the operation.

Still another drawback presents itself in the fact that the melting-point of the vaselin used by Gersuny was relatively about the normal temperature of the human body, that the individual might readily, under the influence of some marked feverish condition, acquire a temperature equal to or higher than the melting-point of the vaselin, the consequence of which is sufficiently obvious.

Eckstein, of Berlin, employs a solid paraffin having a high melting-point of 120° to 130° F. This substance, therefore, has a melting-point considerably higher than that of the tissues into which it is injected. It solidifies rapidly and thus remains in the same situation uninfluenced by muscular contraction or other forces.

Broeckaert has more recently modified Eckstein's procedure. He prefers to use a paraffin melting at 56° C. Mosckowicz now also injects the unguentum paraffin in a solid state. After melting and drawing it into the syringe, he there allows it to cool down until solidification takes place, and then in the form of a fine thread he injects it into the tissues. It is preserved in sealed bottles after the manner of antitoxin serums. The paraffin must be thoroughly sterilized, the sterilizer in which the syringe is boiled also serving as a water-bath in which to melt the paraffin. The post-operative effect depends also largely upon the amount of the material used. It is therefore necessary to avoid the introduction of any excess, as undue tension and destruction of the skin may follow. To avoid this it is sometimes better to repeat the operation if the need arises. From one-half to one dram or one and a half drams is the amount ordinarily required. During the injection the material is molded according to the necessities of the case. A needle-puncture should be sealed by a collodion dressing.

Post-operative Effects.—As a result of the injection, the skin usually becomes white and frequently presents a somewhat swollen and tense appearance. During one or two succeeding days there may be redness and sometimes edema, which is usually of a transient nature. The application of iced boric-acid dressing will minimize the tendency to painful reaction. No second injection should be permitted until all evidence of any local irritation resulting from a previous operation has

subsided. The results of this method of correcting external deformities of the nose are very favorable.

Should suppuration occur, an incision should be promptly made and the paraffin allowed to escape through the sinus or opening which has formed. The after-treatment is similar to the treatment of other septic wounds.

CHAPTER IX.

OPERATIONS (Continued).

CHAPTER IX.

OPERATIONS (Continued).

OPERATIONS UPON THE NECK (TRACHEOTOMY, LARYNGOTOMY, ETC.).

Technic.—If the operation has been performed for the removal of a foreign body, the entire wound can be closed for primary union. If, however, a tracheal tube has been inserted, it is imperative that the patient should be placed in a warm bed, preferably in a semi-erect position, and made as comfortable as possible. The air must be kept fresh and at a temperature of about 65° F., and all possible draft avoided.

The cannula should be made of aluminium. Other metal tubes are heavy, and when allowed to remain in the trachea for a few days, often excite ulceration by pressure. Every metal cannula should be double and fixed in position by means of silk or tape passing through the shield and tied around the neck. When it is intended that the tube shall be worn for some time, it is better not to rely upon a single or straight vertical incision of the trachea, but to exsect a circular portion of the anterior wall equal in size or a little larger than the required cannula. The result will be found more comfortable to the patient, and enable the cannula to be reinserted more easily.

The after-treatment of these patients must be conducted with scrupulous care. The wound must be kept perfectly clean. Great care should be observed to keep the orifice of the cannula free from mucus and the inner tube clean. A tracheal aspirator for the removal of mucous membrane, or possibly foreign bodies, from the air-passages of the trachea should always be at hand. This does away with the filthy and dangerous practice of sucking the tube or cannula when partially obstructed. A piece of dry gauze should always be placed over the tube to prevent the entrance of foreign bodies. This is neatly accomplished by taking an ordinary pill-box, and with bottom and top removed, stretch a piece of gauze over the remaining pasteboard rim and cap this over the orifice of the tube, holding it in position by the bandages carried around the neck. The tube or cannula should frequently be cleansed

of secretion. This should be done as rapidly as possible, the tube being thoroughly disinfected and oiled before it is again introduced.

After the difficulty of breathing has been relieved by the operation, children usually fall asleep for several hours and should not be awakened. A nurse should remain constantly beside the patient for a number of hours after operation. The inner tube should, as a rule, be removed and cleaned every two hours. Any mucus or membrane that is coughed up should be wiped away at once with a piece of gauze dipped in carbolic solution. If the tracheal aspirator is not attainable and the tube becomes blocked with mucus, a small feather may be used for cleansing purposes. If the breathing becomes difficult and the cannula is clear, a steam atom-

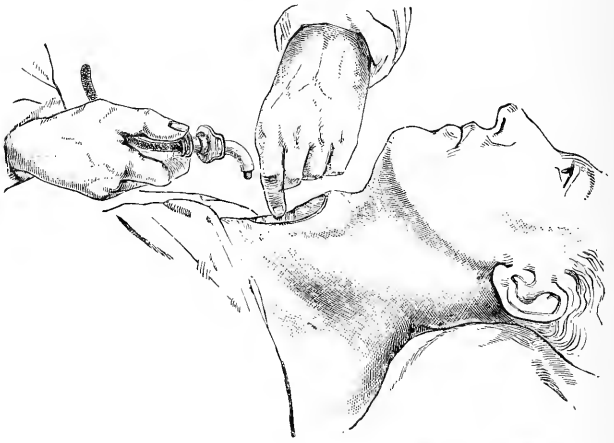

Fig. 48.—Operation for Tracheotomy.—(*Bryant.*)

izer or croup kettle with a solution of sodium bicarbonate, 20 grains to an ounce, will prove very beneficial to the patient. Unless the cause of obstruction is a permanent one, after twenty-four to forty-eight hours attempts should be made to remove the cannula by temporarily stopping the tube with the finger or a piece of gauze. The patient should be allowed to attempt to breathe through the mouth, but before permanently removing the tube, the patient should be gradually accustomed to breathing through the mouth by plugging of the cannula, and if on removing the tube asphyxia or spasms occur, the tube must be immediately reinserted. If the tube has to be retained for more than five or six days, an india-rubber tube should be substituted for the metal. A plan adopted by Dyer when there is great difficulty in getting the patient to breathe

through the mouth is to intube the larynx first and then remove the tracheal tube. After twenty-four to forty-eight hours the laryngeal tube may be removed, and the trachea closed by an antiseptic gauze pad and sterilized adhesive strips.

With regard to the steam tent, or "croup bed," and the measures to be adopted to keep the tube clean, I cannot do better than quote the excellent and practical observations of Mr. Jacobson upon this head:

"While fully aware of the need of moisture when the atmosphere is dry, when the membrane tends to crust and become fixed, I am of the opinion that the unvarying rule of cot-tenting and use of steam is disadvantageous. The weakly condition of children with membranous laryngitis, and all they have gone through, must be remembered. Believing that such seclusion, and so little admission of air, tend to increase the asthenia and any tendency to sepsis, I much prefer to be content to keep off drafts by a screen, which allows of the escape of vitiated air above, using steam, if needful, according to the size of the room, fireplace, etc., and according to the kind of expectoration, whether easily brought up by the cough or feathers, or viscid, quickly drying and causing whistling breathing. If the temperature can be otherwise kept up to 60° or 65°, I much prefer to use a thin flat sponge often wrung out in a warm solution of boric acid. The inner tube must be frequently removed and cleansed—every hour or two at first. If the secretions dry on and cling to it, they are best removed by the soda solution mentioned below. At varying intervals between the removal of the tube, any membrane, etc., which is blocking it, appearing for a moment at its mouth and then sucked back, must be got rid of by inserting narrow pheasant feathers, and twisting them round before removing them. If the exudation is slight, moist, and easily brought up by cough or feather, sponging or brushing out the trachea is not called for, but should be made use of when there is much flapping, clicking, or whistling of the breathing; and if this is harsh, dry, or noisy, instead of moist and noiseless, two of the best solutions are sodium bicarbonate, 5 to 20 grains to an ounce of water, or a saturated one of borax with soda. These may be applied by a hand or steam spray over the cannula for five or ten minutes at a time, at intervals varying according to the relief which is given, or applied with a laryngeal brush, feather, or bit of sponge twisted securely into a loop of wire. When any of these are used, the risk of excoriation and bleeding and the fact that only the trachea and large bronchi can be cleansed, must be borne in mind; and with regard to manipulations for cleansing

the trachea and removing the inner tube, it is most important to remember that the caretaking may be overdone, and a weakly child still further exhausted by meddlesome interference."

Dietetics.—In the matter of nourishment, soup, pounded meat, milk, broth, etc., should be given at first, if necessary through a nasal or esophageal tube. This, however, is not often required. Difficulty in swallowing is liable to occur on the third or fourth day. A little care and encouragement will soon enable the patient, if a child, to overcome this difficulty. Nutrient enemas are rarely necessary except at first, in case there is nausea or vomiting.

INTUBATION.

As a postoperative measure, intubation may be employed to relieve dyspnea or as a curative agent to effect dilatation in deformity of the interior of the larynx. In the adult it is applicable to a large variety of conditions of laryngeal stenosis, both acute and chronic, among which may be mentioned (of the former) obstruction to the larynx or edema of the glottis from any cause; operations upon the larynx; incised wounds or internal violence, as from attempted endolaryngeal operation, foreign body, or the like. The chronic conditions in which it is indicated are such cases of postoperative stricture as may be amenable to treatment by the division of cicatricial bands and systematic dilatation. It is also useful in some cases of laryngeal neoplasm and in laryngeal paralysis threatening asphyxia, which sometimes follow operations upon the throat.

In fractures and other injuries of the laryngeal cartilages involving displacement the presence of the tube acts as an excellent support for keeping the displaced parts in proper position, and from its unyielding nature makes possible the application of supplementary means for supporting the parts from the outside.

The insertion of the tube is less difficult in the adult than in the child. It should be done, if possible, with the aid of the laryngoscopic mirror, although this is not absolutely necessary, the sense of touch in one expert in the operation being sufficient. The difficulty of reaching the larynx with a forefinger of ordinary length, and the greater precision with which the tube can be managed when seen in the laryngoscope, make the latter a very useful aid. In passing the tube the larynx should first be anesthetized with cocain. The patient should be seated as for

the ordinary laryngoscopic examination, and the tube, aided by the mirror, should be introduced as in the infant, except that the finger of the operator is not used as a guide. Instead of this, as is customary in the passage of any endolaryngeal instrument, the aid of the patient is depended upon to open the larynx either by the act of phonation or of deep inspiration. The use of a mouth-gag in the adult is not required. In-

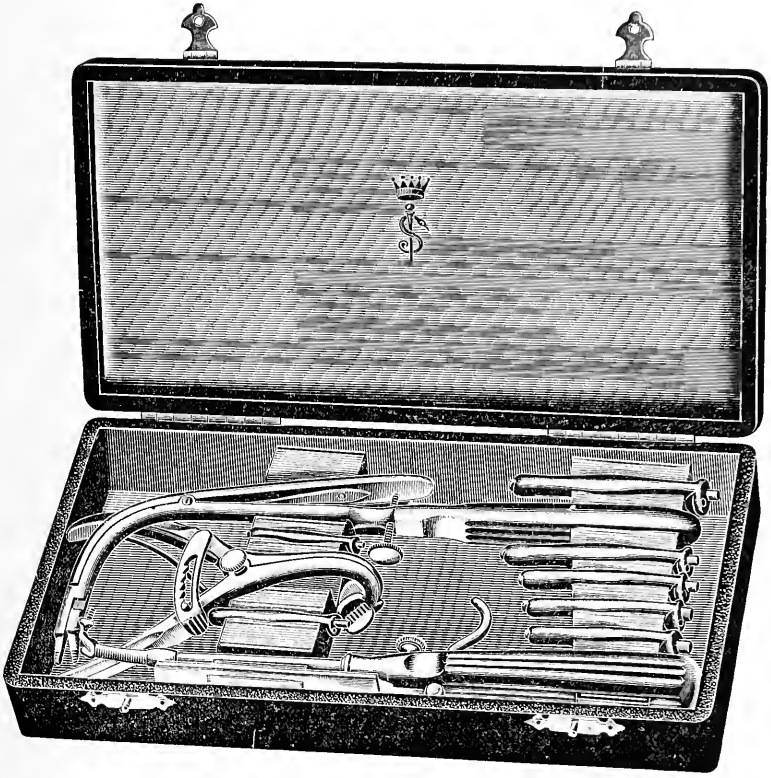

FIG. 49.—O'DWYER'S INTUBATION SET.

tubation in suitable chronic cases has practically superseded all older methods of dilation.

The larynx tolerates the presence of the tube with great readiness, one of O'Dwyer's patients, without his knowledge, having voluntarily carried a tube without removal for fourteen months. Too long retention may injure the larynx, and is not recommended. Such a case should of course be watched, and the tube removed and reinserted as often as required for cleanliness, the condition of the parts, or the necessity for

more active dilatation through the insertion of a tube of larger diameter. The instruments used for the adult are very similar to those for children, except that, owing to the excessive weight of metal, the larger sizes may be made entirely of hard rubber or of the latter and metal combined.

The proper time for removing the tube from the larynx will depend on the age of the patient, the character of the disease, whether of slow or rapid development, and the progress of the case. In diphtheria the younger the patient, as a rule, the longer the tube will be required. In children under two years of age it is better to leave it in seven days. When the above disease has developed slowly, and has therefore run a

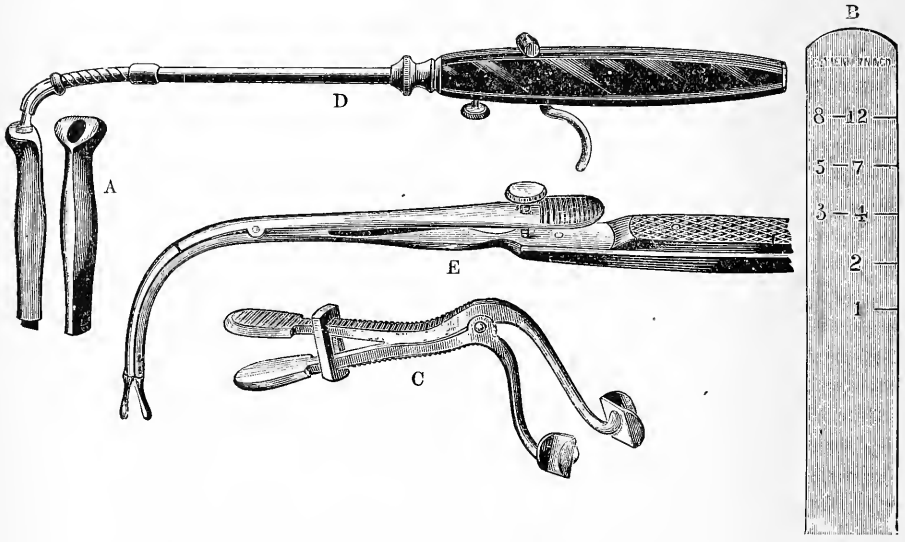

FIG. 50.—O'DWYER'S INTUBATION INSTRUMENTS.
A. Gold-plated tubes. B. Scale. C. Denhart's mouth-gag. D. Obturator or introducer. E. O'Dwyer's extractor.

greater part of its course before calling for operative interference, the tube can be dispensed with earlier—sometimes so soon as the second or third day. If the patient cannot be seen within a reasonable time, it is safer, if progressing favorably, to leave the tube in position for seven or eight days, and the exceptions are few in which it will be necessary to reinsert it after this time. The tube should always be removed on the recurrence of severe dyspnea, because it is sometimes impossible to ascertain with certainty whether or not it be partially obstructed. The best evidence to the contrary is a good respiratory murmur or numerous rales

over the lower posterior portion of the lungs. Even under these circumstances the lumen of the tube may have been encroached upon. In patients refusing nourishment after intubation it is useless to remove the tube for the purpose of feeding, unless it has been in long enough to give some reasonable hope that its further use will not be necessary, as it is difficult to convince children for some time that they can swallow any better than before. If no dyspnea recurs in half an hour after the extraction of the tube, it is safe to leave the patient, if not at too great a distance to be reached within two or three hours.

In feeding children after intubation great care must be taken that food be kept out of the trachea, otherwise a fatal result is pretty certain. Liquid or semisolid food may be given through an esophageal tube or by enema. The best method is to allow the child to swallow it while his head is depressed and a little to one side. (Dennis.)

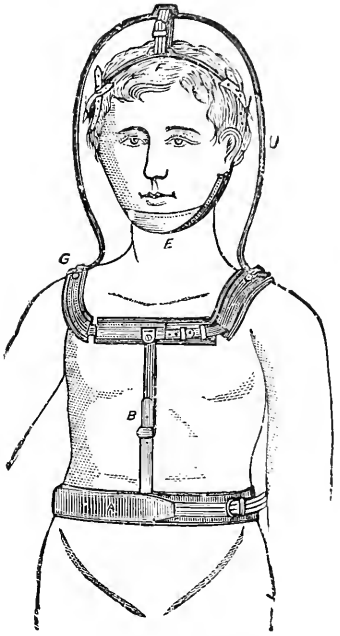

FIG. 51.—DAVIS APPARATUS FOR TORTICOLLIS USED AFTER OPERATION FOR ESOPHAGOTOMY.

A. Abdominal belt. *B*. Front connecting strap. *C*. Head brace. *D*. Steel loop. *E*. Chin strap. *G*. Shoulder braces or pads.

ESOPHAGOTOMY.

After-treatment.—The after-treatment of these cases involves considerable care, and often not a few difficulties.

The patient should lie in bed, with the head and shoulders well raised. The neck must be fixed and made rigid, and this can be effected by means of one of the simpler forms of apparatus employed in cases of cervical caries or torticollis. It is essential that the part be kept at rest, and unless the head be fixed it will be found that the region of the wound is very frequently disturbed, especially when the patient is fed.

The longer the patient can be kept, immediately after the operation, without food by the mouth, the better. The strength must be maintained by nutrient enemas. Thirst may be relieved by rectal injections of warm water. The patient may be fed by a tube on the second or third day. The tube should be soft, and should

be passed by the mouth. This method of feeding must be repeated until the parts are sound. If the wound in the gullet has been closed and has remained closed, the tube may be given up after seven or ten days. If the wound is left open, or if it reopens after it has been closed, the tube should be employed until the wound in the neck is granulating well and has been reduced to small dimensions, and until it is evident that the cut in the gullet has healed.

When the aperture in the esophagus remains free, there is a great disposition for the cervical wound to become very foul, in spite of ordinary attention. The mouth should be frequently rinsed out with a carbolic solution, and the wound, which should be dressed very lightly with gauze, should be irrigated with some aseptic solution many times a day. When the patient is fed with the tube, a little food is very apt to escape into the mouth, and also out of the wound. Both mouth and wound should, therefore, be well washed out after each feeding. It is when milk is extensively employed that the parts tend to become most foul.

Iodoform forms a very suitable material for dusting upon the wound. The chief cause of death in these cases is septicemia, consequent upon the foul condition of the wound. Other elements in the mortality are cellulitis, pneumonia, and exhaustion.

OPERATIONS UPON THE THYROID GLAND, GOITER, ETC.

Technic.—Before closing the incision all hemorrhage must be completely arrested. The smaller arteries should be ligated, as accidental or recurrent hemorrhage after these operations is very frequent, vomiting being the most exciting cause, owing to the vascularity of the parts. To control or prevent persistent oozing after operation for goiter some surgeons now saturate the entire wound with a weak solution of adrenalin chlorid just before the final sutures are placed.

Liability to recurrent hemorrhage is so very common that the patient should be watched carefully for several hours following the operation. Hemorrhage beneath the deep fascia may so compress the trachea as to cause death by asphyxia. A sudden onset or attack of difficult breathing, accompanied with cyanosis, calls for hurried relief. The wound should be quickly torn open and issue given to the blood. Instead of sealing these wounds with collodion, as is sometimes done, if a small piece of gauze or guttapercha is introduced before closing the wound, hemorrhage will be quickly noted and other complications avoided. Usually within twenty-four to thirty-six hours after the opera-

tion when no drainage is used, marked swelling of the tissue around the gland is often observed; this, however, rarely calls for treatment and gradually disappears. During convalescence, symptoms of thyroidism may suddenly appear, the most prominent of which are tachycardia, tremor, headache and drowsiness, and rapid breathing with marked exhaustion. This is believed to be due to the absorption of colloid material. When this does occur, the wound should be opened and carefully irrigated. Rest and protection from excitement are essential conditions to successful treatment. Medically, the treatment is mainly directed to the symptoms, the remedies mostly used being bromids as nerve sedatives, and digitalis to slow and steady the pulse. Later, nux vomica in large doses, as recommended by Newton, may prove efficient. Subnormal temperature with rapid breathing, associated with cyanosis and swelling of the vessels of the neck, may call for adrenalin and other heart stimulants with hypodermatoclysis. Of 68 cases reported by Oppenheimer, there were 9 deaths within twenty-four hours.

FIG. 52.—COLLOID GOITER.—(*Richardson, after v. Bruns.*)

ABSCESS OF MASTOID.

Treatment.—After removal of pus and all necrosed bone, the wound should be treated after the open method. Free drainage is requisite. The cavity of the abscess and the antrum should be very gently packed with 5 percent iodoform gauze. This packing is removed, when loosened, on the third or fourth day. The antrum and cavity should be freely irrigated with an antiseptic lotion posteriorly, and the

fluid allowed to pass out of the canal. When thoroughly cleansed, the cavity and antrum should again be packed lightly with gauze. It will be necessary in some cases to leave a drainage-tube *in situ*, especially when the abscess-cavity is very foul and the pus is fetid. When a drainage-tube has been inserted and there is a discharge of pus, the parts should be irrigated with a weak boric-acid solution, and afterward covered with iodoform gauze and absorbent cotton and bandaged. Surgeons in some instances, when there is a chance of healing of the aseptic wound, reinsert the disk of bone. If there is much discharge, the dressings should be changed each day.

"The bone which separates the mastoid cells from the lateral sinus is very thin, so that when erosion of the bone occurs, inflammation may easily extend to the lateral sinus, causing thrombosis of the same, and emboli may be thus transmitted to the cerebrum or cerebellum and form an abscess, or abscess may be developed by direct inflammation through the dura mater, or in rare instances by inflammation extending to the cerebellum through the sheath of the auditory meatus. Abscesses are also found between the dura mater and pia mater." (Dennis.)

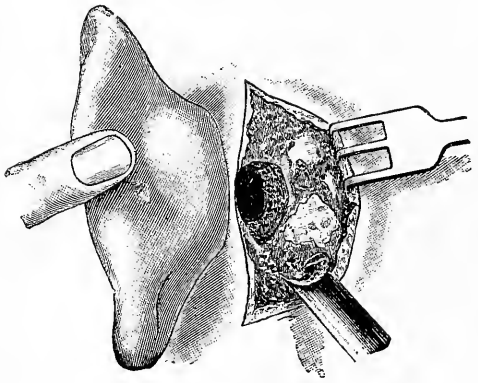

FIG. 53.—OPENING THE MASTOID ANTRUM.—(*Esmarch and Kowalzig.*)

Complications. — The sudden onset of a rigor, followed by a rise of temperature, headache, vomiting, etc., indicates meningitis. Under such circumstances the wound should be at once reopened. All drainage should be removed and mild antiseptic lotions used freely. Should these means not suffice, meningitis or abscess may be expected, and every effort should be made to locate and evacuate the pus. It is to be remembered, however, that the brain-substance, being poorly supplied with lymphatics, abscess in its interior does not, as a rule, cause rise of temperature. More frequently in abscess of the brain-substance the patient's temperature is normal or subnormal.

We should examine carefully with a probe to see if a sinus exists in the upper wall. If not, we may then suspect a temporosphenoid abscess,

and an incision should be made upward above the zygomatic process, and with a trephine remove a disk of bone 3 cm. in diameter at a point (see Fig. 53) of the external auditory canal from 2.5 to 3 cm. above the external meatus. In abscesses in the brain due to middle-ear disease Keen trephines at "Barker's point"—1¼ inches above and 1¼ inches back of the extreme auditory meatus. Horsley also follows this rule. After removing the disk of bone, if the abscess is large, there will probably be some bulging of the dura mater into the opening. There may or may not be absence of cerebral pulsation. The dura should be divided and the arachnoid and pia mater examined. By means of a hypodermatic syringe and needle the different portions of the brain can be explored for abscess. The needle should be introduced so as to cover the cranial surface of the tegmen tympani. After the pus has been evacuated the abscess-cavity should be washed out with a very weak boric-acid solution and but very little pressure used; otherwise the brain-substance may be injured.

EMPYEMA OR PLEUROTOMY.

Postoperative Treatment.— When a permanent treatment is to be provided, the opening should be made at the lowest part of the cavity—in the mammary line, by removing the cartilage of the sixth rib; in the lateral region, the right pleura may be opened by removing the ninth rib; and the left, by removing the tenth rib; posteriorly in the scapular line on either side, by removing the twelfth rib, the presence of fluid being previously ascertained by puncture or aspiration. After a free opening has been made, a probe or the finger is introduced to ascertain the deeper part of the cavity, over which a second opening may be made by resection of a portion of the rib. In this way provision is made for syringing the pleural cavity through the two openings. (Kocher.)

Schede has demonstrated that expansion of the lung takes place best when the thorax is opened at the deepest and most posterior part. By following Schede's procedure, the cavity may be at once washed out, a short T-shaped drainage-tube being used to permit the free escape of fluid. Repeated washing out of the cavity should be avoided, as, according to Schede, it interferes greatly with the adhesions of the pleura. Fetid empyemas, however, should be washed out, and retention of pus must be prevented by efficient drainage. In purulent pleural exudation thorough and early evacuation is the best procedure. Complete mobility and expansion of the lung is best obtained by early and thorough operation.

The dressings becoming soiled permit the air to escape from the cavity upon forced expiration, but by compressing the drainage-tube or opening the ingress of air may be impeded.

Hutton seeks by means of a very ingeniously contrived mechanical device to permit thorough drainage, and upon forced expiration, the escape of air; but by the action of the valve in the device the air is prevented from entering the cavity, and thus secures the operation of atmospheric pressure, preventing collapse of the chest walls.

Délorme has lately suggested a method for bringing about the closure of old empyema cavities, which, when available, gives a better result than ordinary methods. After opening the pleura he separates extensively the adhesions to the lung and then performs a decortication of the cicatrized tissue from the surface of the lung, thus enabling the lung to expand sufficiently to come in contact with the inner wall of the chest. If on dividing the pleural adhesions it is found that the lung is still capable of expansion, and that the adhesions can be peeled off, nothing further is required, providing the lung expands sufficiently to fill up the cavity; but if the lung does not expand sufficiently, Depage's operation should be resorted to, and one or more ribs resected from the pleural surfaces of the raised flap, commencing with the lowest one.

Christie, Jr., reports a most gratifying result from the following method: The case is treated as a simple drainage case—that is, with resection of one rib and drainage through a tube for three weeks. At this time union and moderately firm cicatrization of the cutaneous and subcutaneous incision will have been secured, and there will remain a simple sinus leading into the pleural cavity. By means of a simple apparatus which is attached to the vacuum chamber of an ordinary aspirator he forcibly extracts all the air from the pleural cavity and at once secures the effect of full atmospheric pressure within the lung and against the thoracic wall, which forcibly induces the immediate expansion of the lung, after which the wound is effectually plugged by means of a water-cushion and rubber dam eight inches wide; the purpose of the dam being to form an impervious contact with the chest walls.

Should irrigation of the pleural cavity at any time be considered desirable, normal salt solution or weak iodin solution only should be used. The drainage-tube must be continued until all discharges have ceased entirely. The patients, who are, as a rule, very much emaciated, should be placed upon tonics with forced nutrition.

Senn's Method of Drainage and After-treatment.—Tubular drain-

age is the ideal method of draining a suppurating pleural cavity. Two fenestrated tubular drains the size of the little finger and about four inches in length, securely fastened together with a large safety-pin or a stitch through each end, should be used for this purpose. This precaution is absolutely necessary, as drains have been frequently lost in the pleural cavity for want of securing with a large safety-pin. After inserting the tubular drain, the external wound is sutured in the usual manner. The curved incision, as previously described, not only exposes the rib more freely than the straight incision as usually practised, but also is much better adapted for efficient prolonged drainage.

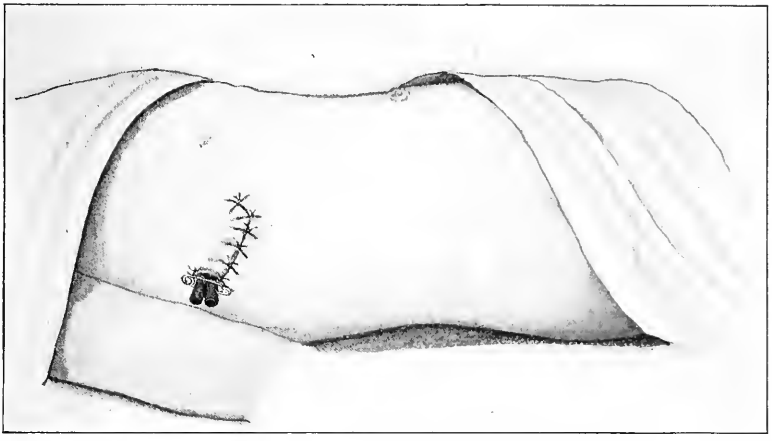

FIG. 54.—EXTERNAL WOUND PARTLY SUTURED; DOUBLE DRAIN IN PLACE.—(*Senn.*)

It is not advisable to irrigate the cavity the day the operation is performed, and irrigation at this time is always contraindicated if the empyemic cavity is in communication with the bronchial tubes. Irrigation may become necessary later if the suppuration continues. If irrigation becomes necessary at any time, care must be exercised in the selection of the solution; carbolic acid and corrosive sublimate in the usual strength are dangerous and should never be used. A nontoxic and yet potent antiseptic solution should be used—either a saturated solution of aluminium acetate or Thiersch's solution. Either of these solutions is efficient as an antiseptic, and nontoxic even when used in large quantities. The value of the double drain is made more apparent when it becomes necessary to irrigate the pleural cavity. By placing the patient on the opposite side the fluid that enters the chest through

one of the tubes escapes through the other as soon as the cavity is full, thus washing it out thoroughly. By placing the patient on the affected side the cavity is emptied, when the same procedure is repeated until the solution returns clear. The solution used must always be heated to blood-temperature, as irrigation with a cold solution is fraught with danger. I have seen, in the case of a child, almost fatal collapse attend irrigation of the pleural cavity with a solution at room-temperature. It required persistent and prolonged efforts to restore the suspended respiration by the administration of stimulants and artificial respiration. The external dressing consists of a large and thick cushion of sterile gauze and cotton to absorb the fluid as fast as it escapes, and at the same time to provide the wound with a filter to prevent postoperative infection. There is no special advantage in using medicated in place of sterile absorbent material, so long as the compress is removed, as it should be, as soon as indications of saturation appear on its surface. The best way to retain the dressing in place and to prevent the entrance into the pleura of unfiltered air is to substitute for the ordinary bandage the rubber-webbing bandage, or to place over the gauze roller, over the upper and lower margin of the dressing, a band of the rubber-webbing bandage. Change of dressing and antiseptic irrigation become

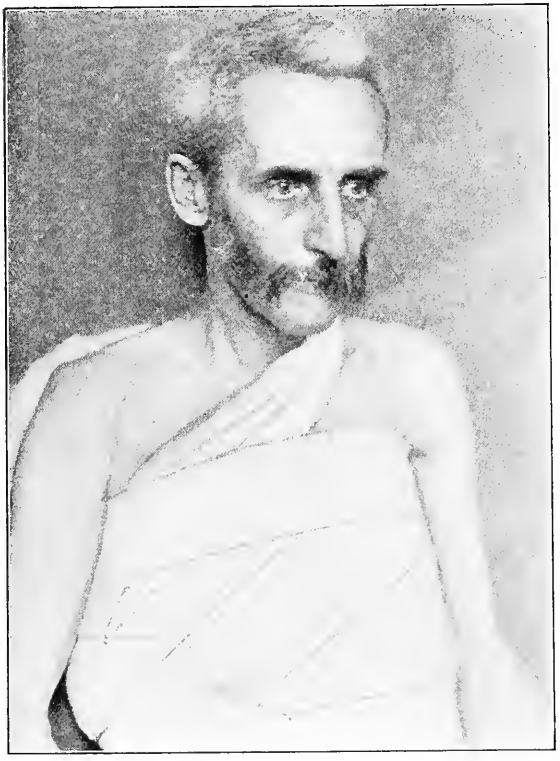

FIG. 55.—DRESSING AFTER OPERATION FOR EMPYEMA.—(*Senn.*)

necessary as often as the dressing becomes saturated. For the purpose of obviating frequent changes the dressing should be at least six inches thick and cover the whole side of the chest. As the cavity diminishes in size the drains are shortened from time to time, and sooner or later one of them can be dispensed with. Premature removal of the drain is often followed by relapse; drainage must not be suspended until the surgeon can satisfy himself by careful examination that the pleural cavity has become obliterated. Should the lung fail to expand sufficiently in the course of a few months to place the cavity in a condition for definitive healing, Schede's thoracoplasty is the operation of choice, as Estlander's multiple rib resection has not yielded the expected results in the practice of many operators, including myself.

It is well for the surgeon to keep close watch on the size of the empyemic cavity during the after-treatment, not only for the purpose of keeping himself well informed of the progress of the healing process, but also with a view to determining the time when it is safe to abandon drainage. For a long time it has been my custom to place my patient, at stated intervals, on the opposite side, then to fill the cavity with one of the antiseptic solutions used for irrigation, then evacuate the chest by reversing the position, and measure the quantity of fluid removed. This procedure can be relied upon in giving the size of the cavity, and should be employed systematically at fixed intervals, to ascertain the proper time for the removal of the drain.

AMPUTATION OR EXCISION OF THE BREAST.

Technic.—The operation, although extensive, is usually performed with little loss of blood, and therefore with little shock. The wound should be closed by bringing together the flaps so that the axilla at least is completely closed. A single drainage-tube should be inserted well below the lowest part of the incision and extend upward between the chest wall and muscular tissues as far as the clavicle. Any part of the wound which cannot be closed should be at once grafted by Thiersch's method.

"The functional disturbances which follow such an extensive operation and removal of muscle are not so severe as one would expect, because the anterior fibers of the deltoid are able to pull the arm forward, and the latissimus dorsi to adduct it. The complete removal of glands is a more important matter, and the obstruction to the flow of lymph,

especially if the main vein has been ligated, is a more serious complication. In this case a solid edema develops, with elephantiasis of the arm, which may last for months or years, and which interferes much more with the function of the arm than does removal of the muscle."—(Kocher.)

After-treatment.—A matter of considerable importance, so often overlooked in the after-treatment for excision of the breast, is the position of the arm during convalescence. Many surgeons teach or insist upon immobility, fixing the arm either by adhesive plasters or bandages immediately after the operation. This is not good practice.

FIG. 56.—ILLUSTRATES THE CUSTOMARY METHOD OF BANDAGING OR DRESSING THE ARM AFTER EXCISION OF THE BREAST.

Triangular Dressing of Arm after Excision of Breast.—J. A. Bodine has devised a method of dressing the arm during healing after breast amputations. (Fig. 58, page 182.) He uses a triangular splint which places the arm at a right angle to the body. He calls attention to the consequent freedom with which the patients can use their arms. He has been using this dressing in all such cases for the past few years. An isosceles triangle, made of light splint wood, held in position by rubber adhesive strips, is so placed against the side of the chest that the upper arm is at a right angle to the body, while the forearm in supination rests along one side of the triangle with the hand resting upon the hip. The triangle presses along the body between the line of incision for removal of the breast and the posterior puncture made for the drainage-tube. The arm being in this position, the patient is perfectly comfortable while in bed and also while walking about. Adherence of the skin flap and scar to the under surface of the arm after enucleation of the axillary contents is an inch and a half to two inches nearer the shoulder than it is when bound against the chest. It is this difference in position

of attachment of the scar and skin flap to the arm that gives such freedom from cicatricial contraction following amputation of the breast.

Dawbarn has several times employed the method demonstrated by Bodine. It is more comfortable because the abduction of the arm slides the scar so that it does not adhere to the region of the vein nor the main lymphatics. Patients at times have been made very miserable after amputation of the breast by swelling of the arm, due to adhesion of the scar, the forearm and arm becoming large and edematous and annoying the patient for a long time. This may be avoided by carrying the incision up the middle of or even posterior part of the axilla, although the main dissection is sharply forward in the anterior portion of the axilla where the main vessels lie. In commenting upon this method of dressing Dawbarn ("Albany Medical Journal") writes: "There is only one muscle which can take the place of the pectoralis major and minor, both of which must be entirely removed in the modern operation, and that is the deltoid. It is wonderful how this muscle, hypertrophied, and being inserted into the outer third of the collar-bone, with a very poor leverage, accomplishes its mission." In the case of women who have very weak deltoids, it has been part of his regular operation of late years to dissect free from the clavicle one inch of the anterior edge of the deltoid, and to carry it inward so far as it will easily go, and then to sew it to the stump of the pectoralis major. That muscle, in course of time, becomes hypertrophied, and it helps a great deal; but in cases in which this operation is performed it obviously would not do to use the isosceles triangle, with its necessary abduction of the arm. In the technic just described, as to the deltoid, the cephalic vein is liable to cause trouble, and he generally ties

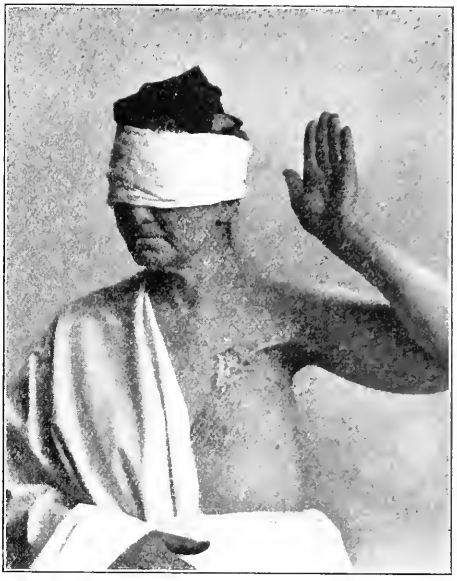

FIG. 57.—SHOWS THE ORDINARY RESULT WITH CONTRACTED SCAR AND LIMITED MOTION OF ARM.

it off, but this may not be necessary if great care is taken. It is only when the axillary vein is involved in the cancerous growth that saving the little cephalic vein becomes a matter of importance.

FIG. 58.—BODINE'S METHOD OF DRESSING AFTER BREAST AMPUTATIONS, ALSO SHOWING ANGULAR SPLINT.

For several years we have abandoned the customary or fixed method of dressing as wholly unnecessary, if not harmful. The arm should be practically free, and the patient allowed to move it gently as early as possible. The results are often surprising: pain ceases much sooner, and a free and movable arm is the outcome. Fig. 59 illustrates the author's method of bandaging with the arm free. A wedge-shaped pad of absorbent cotton holds the arm outward and prevents contact with the

FIG. 59.—AUTHOR'S METHOD OF DRESSING AFTER AMPUTATION OF RIGHT BREAST. ARM FREE AND MOVABLE.

FIG. 60.—SAME, SHOWING MOBILITY OF ARM TWENTY-ONE DAYS AFTER AMPUTATION OF BREAST.

breast. Fig. 60 illustrates freedom of motion a few weeks following the operation.

The after-treatment is practically the same as after other operations or large wounds. All saturated dressings should be removed as early as possible, and fresh ones applied over the wound after twenty-four hours. The drainage-tube should be shortened at the daily dressings until all discharge ceases. The stitches require removal in from nine to fourteen days, support being given with sterile adhesive straps.

CHAPTER X.

OPERATIONS ON THE STOMACH, LIVER, AND INTESTINES.

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OPERATIONS UPON THE STOMACH.

General Remarks.—In gastroenterostomy and other operations upon the stomach faulty technic or failure to select a proper site for the anastomosis not only retards recovery, but often complicates seriously the postoperative treatment of these cases. Patients requiring such surgical interference are very frequently markedly emaciated, and the stomach, as a result of the decomposed food and retained contents, very frequently becomes elongated or distended to such a degree as to cause a deformity in its outlines. This element of deformity is an important factor in the explanation of the unsatisfactory conditions which persist after many of these operations, and must not be overlooked. (Ochsner.)

In order to secure proper drainage of the stomach it is essential that the lowest possible place in the stomach should be chosen. The selection also of a proper point in the small intestines, not too close to the pylorus, and, lastly, the avoidance of tension of both gut and stomach, are likewise of the greatest importance. (Mayo.) Good and sufficient drainage is manifest by immediate improvement in the patient's nutrition and general condition. When there is evidence of retention of blood or mucus within the stomach immediately following the operation, the pharynx should be cocainized to prevent retching and vomiting, a stomach-tube inserted, and gastric lavage with normal salt solution gently given, in order not to overdistend the stomach. It is often surprising to find how much fluid will collect in the stomach after this operation. (Ochsner.) It is my experience that the use of the Murphy button in gastroenterostomy is attended by more discomfort or pain to the patient than the ordinary suture method, the mechanical weight of the button causing an unpleasant feeling or dragging sensation; and it sometimes happens in greatly reduced patients that a sudden jar or jolt, such as a paroxysm of coughing, sneezing, or vomiting, may cause a loosening of the button or drag it from its position in the stomach. When the Murphy button is employed in gastroenterostomy, it is therefore advisable to rein-

force the place of anastomosis by employing the adjacent omentum as a covering, as recommended by Nicholas Senn and others.

Postoperative Treatment.—The patient should not lie flat on the back in bed after stomach operations, especially after gastroenterostomy, since the escape of stomach contents into the intestine is facilitated by the patient being slightly propped up. In some cases, too, turning on the right side also facilitates the outflow of stomach contents. It is unnecessary to state that the patient must not move himself, but must allow the nurses to change his position. This change of position also has an influence on the bowels, since it often relieves gaseous or fecal accumulation.

Lavage.—If vomiting and eructation continue after the second day, and especially if at the same time the temperature is elevated, the mouth dry, and the tongue sticky and coated, it is almost certain that there is some decomposition of stomach contents. If these contents are allowed to remain in the stomach, they will probably produce a fatal issue, either by setting up diarrhea, by keeping up vomiting, or by absorption of toxins. It is very important that they should be removed at once; to do this, a stomach-tube must be passed, and the stomach thoroughly washed out with some antiseptic, such as salicylic acid, followed by plain boiled water, which must be continued until the fluid returned is quite clear. Feeding must be recommenced immediately after the lavage, as this will be a favorable time for the absorption of nourishment. The lavage must be repeated on the next day if vomiting or eructation continues. In some cases it may require to be done daily for five or six days.

Some hesitation might be felt at passing a stomach-tube forty-eight hours after suture of the stomach, and injecting water to wash out its contents, since this might place a strain on the stitches; however, it is far better that a suture should undergo a slight strain than that it should be soaked in a putrid liquid; besides, the wound in the stomach is firmly sealed at the end of forty-eight hours, and it will probably resist any pressure that is likely to be exerted in gastric lavage. The lavage, of course, must be done gently, the patient lying on his back, and the fluid introduced by means of a funnel which must not be more than three feet above the patient's head; it is removed by siphon action, not by expression.

Laxatives.—A goodly number of cases of operations on the stomach never require any aperient, and the bowels act naturally on the second or third day; in some instances the other extreme is reached, or a troublesome diarrhea may follow which may cause a fatal issue

without leaving any signs at necropsy. In all cases of diarrhea the amount of liquids given should be diminished, and tincture of opium must be administered by the mouth, and the stomach washed out; this will usually stop the diarrhea.

Rectal Feeding.—Rectal feeding in all operations upon the stomach is requisite for several days, and some account of the best form of carrying this out will be useful.

In the first place, before commencing nutrient enemas it is best to wash out the bowel thoroughly with normal saline solution; this must be repeated each day to remove the débris. The patient should be lying on his back, and should not change his position for some time after the injection. The best method of introduction is to use a soft-rubber rectal tube the size of a No. 12 or No. 14 catheter, which should be passed about six inches up the rectum; connected with the tube is a funnel which should be raised two feet above the bed. This is better than a syringe, since the fluid will flow more evenly and slowly into the rectum, and so is more likely to be retained; the risk of forcing in air, too, is diminished. The whole enema should not exceed six ounces in bulk, and in some irritable rectums only three or four ounces should be given; it should be of a temperature of 100° F., and should be given every four or six hours. Practically only substances in solution can be absorbed from the rectum, so unpeptonized milk or beef-tea is useless; stimulants, such as spirits, wine, tea, or coffee, are most readily absorbed, but extractives and peptones are also of value. The necessity of giving digested meat has been recognized for a long time, but the process of preparing the enemas has been much improved by the introduction of the various peptonizing or digestive powders now on the market. The older enemas were prepared with fresh pancreas. The following are a few of the best:

1. Von Leube's: Five ounces of finely scraped meat is chopped very fine, and to this is added one and a half ounces of finely chopped pancreas; the whole is suspended in three ounces of lukewarm water, and stirred to the consistence of a thick pulp. This makes one injection.

2. Mayet's: 150 to 200 grams of pancreas is bruised in a mortar with tepid water at a temperature of 100° F., and is then strained through a cloth; 400 to 500 grams of lean meat is chopped fine, and the strained pancreatic fluid is mixed with the mince, together with the yolk of one egg. This is allowed to stand for two hours, and administered at the

body-temperature; the quantity is sufficient for twenty-four hours' nourishment, and should be administered in two parts.

3. Rennie's: Half a pound of lean meat is pulled into shreds and added to a pint of beef-tea; to this are added one dram of fresh pepsin and half a dram of dilute hydrochloric acid; the mixture is kept at at emperature of 99° F. for four hours, during which it is stirred constantly. If too great heat is employed, the digestion will stop.

4. The enema which the author employs is made as follows: Milk 2 ounces, strong beef-tea 2 ounces, yolk of egg 1, pancreatic solution 1 dram. This is to be prepared one hour before use, and to be kept at a temperature of 100° F. One-half to one ounce of brandy is added, when necessary, immediately before use.

5. Terrier and Hartman recommended the following: Peptones 20 grams, infusion of tea 100 grams, benzonaphthol ½ centigram, tincture opium 5 minims. Four of these are given during the twenty-four hours.

6. Greig Smith's: One egg is beaten up in six ounces of milk, and two or three teaspoonfuls of meat jelly or peptones added. This is administered warm with or without half an ounce of brandy every five or six hours.

7. Hunter Robb's: Peptonized milk 1 ounce, whisky ½ ounce, the whites of 2 eggs, common table-salt 14 grains.

Nutrient suppositories are also used when the rectum is intolerant of injections, or they may advantageously be used alternately with them in cases requiring several days' rectal feeding. If used alone, they must be supplemented by an injection of about half a pint of hot saline solution once or twice a day. The suppositories are usually made of peptonized beef, a chocolate-colored paste which is prepared by digesting beef with acidified fresh gastric juice, and then concentrating the solution. The suppository contains 30 grains of this, and is stiffened with cacao-butter. These suppositories are made by most wholesale chemists, and keep only for a short time after the box is opened. It is best to use them freshly prepared.

Lastly, Sansom has recommended the use of blood as an enema. Ox blood is usually employed, and must be defibrinated first; this can be obtained from a butcher by asking for whipped blood. It must be fresh, and will not keep more than one day. By the addition of one and a half grains of chloral to one ounce of blood all offensive odor is overcome. It is usual to inject two or three ounces of blood every two or three hours.

In case rectal feeding has to be continued for any length of time it is

well to change the composition of the enema, since the rectum does not appear to retain any one kind of enema long. If, too, the rectum be irritable, two or three minims of tinctura opii should be added to each enema. Some surgeons also add some disinfectant to each enema, either betanaphthol or salol; from 2 to 5 grains of each can be given. Alcohol also acts as a disinfectant, as well as a stimulant, so this is an additional reason for adding either brandy or red wine, as suggested by Ewald. (See also article on Rectal Alimentation.)

CHOLECYSTOTOMY.

General Considerations.—Operations upon the gallbladder should be deferred, if possible, until all symptoms of acute inflammation have entirely subsided. When catarrh or inflammation coexists, simple cholecystotomy should not be performed. A relatively small incision in the abdomen is usually all that is required. If the walls of the gallbladder are found to be normal so that the indication is merely to remove the contents, especially gallstones, the gallbladder is drawn into the wound and fixed there firmly by means of forceps. Sterile gauze tampons are now carefully inserted well around the gallbladder to prevent infection and entrance of bile into the peritoneum. The fundus may now be incised, the fluid contents evacuated, and the calculi removed by means of a scoop and forceps. After the extraction of the stones the wound in the gallbladder is closed by a double row of sutures, as in suture of intestines. The gallbladder is then replaced, all gauze packing removed, and the wound is carefully closed by deep sutures and sealed. Many surgeons, however, prefer to treat the wound after the open method—*i. e.*, a strip of iodoform gauze is introduced down to the sutured gallbladder and allowed to remain three or four days, after which it is removed, and if there is no indication of infection or leakage from the gallbladder, the wound is closed or drawn together with adhesive plaster. When gallstones have become impacted in the ductus choledochus, the surgeon is confronted with a new set of indications for treatment. The prognosis is then more unfavorable, because the patient is the subject of jaundice, and an old-standing icterus produces an exceedingly dangerous hemorrhagic diathesis. A larger incision is usually required. The gallbladder is exposed. Iodoform gauze is gently but thoroughly packed around the gallbladder, and especially the lower portion, to prevent, as before, any possible infection of the peritoneum. The gallbladder is drawn well into the wound and stitched carefully with four to six sutures to the

subcutaneous tissues, but not to the skin. Block and other surgeons operate in two stages; this is required, however, only in exceptional cases when infection is present to such a degree as to endanger extension to the peritoneum. In these cases the safest plan is to wait; suitable gauze dressing and bandage are now applied over the external wound and the patient is removed from the operating table. Three or four days suffices to form complete adhesion between the tissues and to wall off all danger of infection of the peritoneum. The gauze packing will also become loosened, which permits its easy removal, and the patient is ready for the second stage of operation. As a matter of safety, the wound, or lower portion at least, should be again packed loosely with iodoform gauze. The gallbladder may now be incised and stones removed, after which a glass tube with iodoform gauze packed around it is inserted for the purpose of drainage and thus a *cholecystostomy* is done. Many surgeons make extensive use of this operation because they lay great weight on drainage of the bile-passages. By using Morrison's method for drainage where leakage is inevitable, a rubber tube is inserted through the wound in front and extends to the deepest part of the gallbladder, or the gallbladder may be drawn over the tube as far as deemed necessary, and fastened by means of a strip of iodoform gauze wrapped around the tube including the gallbladder tissue, thus preventing all leakage. The rest of the wound is carefully packed with iodoform gauze.

Many very serious cases thus treated have resulted ultimately in perfect recovery. In chronic inflammation with calculi but no pus, Ross passes a tube into the bladder, stitches the opening firmly around the outer wall of the tube, packing the wound with iodoform to wall off the peritoneum. Another packing is put in at the bottom of Morrison's pouch; the latter is removed about the fourth or fifth day and the former in one week or ten days, when the impacted stone can be safely removed.

In all cases of protracted icterus special stress must be laid upon the most careful arrest of hemorrhage, owing to possibility of a fatal reactionary hemorrhage occurring from a small vessel. Capillary oozing in these cases usually appears the second or third day following operation. Mayo Robson recommends as a preventive measure the use of calcium chlorid, 20 grains or more every four hours for several days prior to the operation. When there is protracted icterus, instead of incising the gallbladder, Kocher recommends choledocholithotripsy with the fingers or forceps. This can be performed safely, however, only when the stone is soft and can easily be grasped; otherwise the open method must be em-

ployed, relying on firm gauze packing and pressure to overcome the hemorrhage. Cholecystenterostomy, so far as after-treatment is concerned, is a much better procedure than cholecystotomy, especially if the operation is performed by the aid of a Murphy button of small caliber. The latter has been shown to be well adapted to this operation because

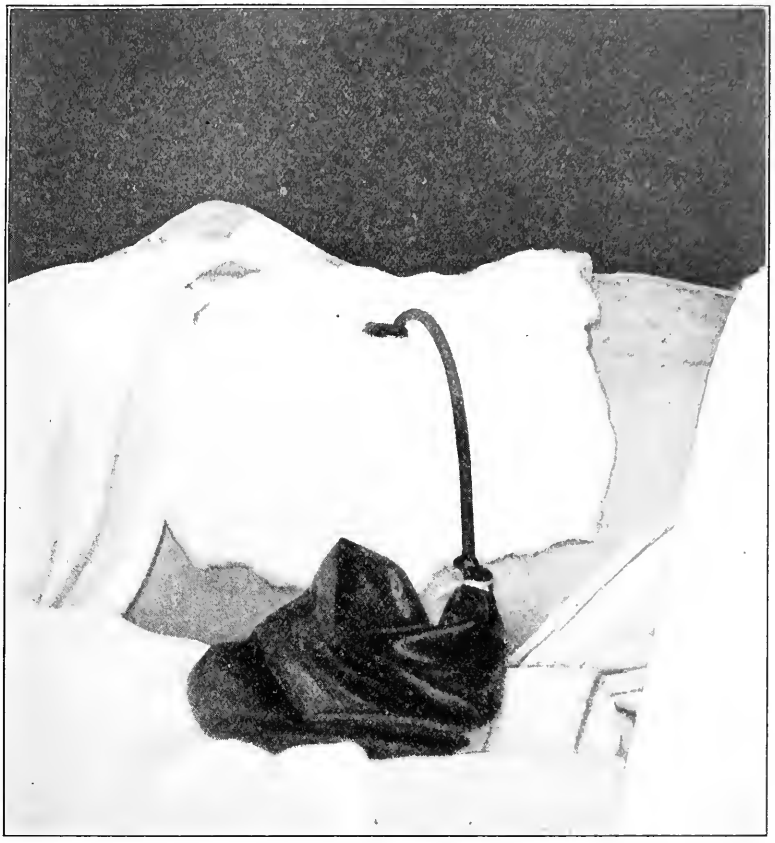

FIG. 61.—ILLUSTRATES MORRISON'S METHOD OF DRAINAGE OF THE GALLDUCT, SHOWING FIRST LAYER OF DRESSINGS IN A FLESHY SUBJECT.

of the rapidity and the ease with which it can be adapted and the certainty of rapid union which it offers; and, lastly, it allows of the immediate closure of the external wound and saves the patient the unpleasantness of an external fistula.

Since the postoperative treatment of operations upon the gallblad-

der is dependent so largely upon drainage, I deem it advisable to give in detail other popular methods.

Kehr's Method of Drainage after Operations on the Gallbladder.—Kehr's wide experience in gallstone surgery has led him to the conviction that it is wise to incise and sound the common bileduct in every case of gallstone, and that every choledochotomy should be followed by drainage of the hepatic duct. This procedure combined with cholecystectomy has given the best results and the safest protection against recurrence, and is indicated in every case in which it does not add materially to the operative dangers.

Drainage of the hepatic duct is secured by inserting a rubber drainage-tube through the choledochotomy incision and pushing it in toward the liver for the distance of four centimeters. The tube is fixed to the choledochotomy wound, and the remainder of the wound is closed by silk sutures. The ends of all the sutures are left long to permit of their withdrawal at a later period. The drainage-tube is then surrounded with gauze strips folded lengthwise. The first tampon is laid over the foramen of Winslow; the second, firmly over the surface of the liver from which the gallbladder was excised; the third above the cholecystectomy incision on the ligamentum hepatoduodenalis; and the fourth on the ligatures of the cystic arteries and ducts and the sutures of the common bileduct; while the fifth tampon is placed between the drainage-tube and the stomach or duodenum.

Berger thus presents his conclusions after a study of 97 cases of gallstone in which drainage was employed by the above method in Kehr's private hospital.

1. Drainage of the hepatic duct is to be preferred to incision and subsequent suture of the duct, because (*a*) it exerts a curative action on the coexisting cholangitis; (*b*) it permits of the later extraction of stones not removed at the time of the operation; and (*c*) it can be performed more quickly.

2. Drainage of the hepatic duct is generally indicated in cases of active cholangitis, and in the cases in which it is not possible to remove all the stones from the hepatic and common ducts at the time of the operation.

3. Drainage of the hepatic duct is also advisable after every case of choledochotomy, even though the bile is clear and the presence of further stones cannot be demonstrated.

4. It is the safest and best procedure to be employed in the cases

in which the history and clinical signs point to stone in the biliary passages but in which no stone is found at the time of the operation. It is also to be recommended in every case of cholelithiasis, provided the operative dangers are not too greatly increased thereby.

5. It is contraindicated in cases of acute suppurative cholecystitis on account of the dangers of spreading infection. Exception may be made to this rule when the patient behaves badly under the anesthetic and tends to become cyanotic when the tissues in the depth of the wound are handled.

6. Drainage of the hepatic duct may be comparatively easy or extremely difficult, depending upon the conditions found at the time of the operation. The best location for the incision is in the supraduodenal portion of the duct. Firmly fixed concretions must be removed by special incisions (hepaticotomy, papillotomy). Fistulas should not be allowed to close until the bile is clear and the surgeon feels convinced that all inflammation has subsided and that no more stones are lodged in the hepatic or common ducts.

7. The results of drainage of the hepatic duct are extremely satisfactory. It not only prevents further extension of an existing cholangitis, but it also brings about a cure. It permits of the subsequent extraction of stone in about 17 percent of all cases, and thereby prevents recurrence, which could not have been avoided after suture of the choledochotomy incision.

8. The benefits to be derived from drainage of the hepatic duct are not unlimited. It is valueless in cases of diffuse cholangitis and in cases in which numerous gallstones occupy a position high up in the liver.

9. Drainage of the hepatic duct is not in itself an especially dangerous operation. In uncomplicated cases its mortality (from pneumonia, vomiting of blood, and acute dilation of the stomch) is not more than 2 or 3 percent.

10. Complications, such as extensive cholangitis, long-continued icterus and cholemia, extensive adhesions, hepatic cirrhosis, pancreatic affections, and fistula formation between the biliary system and the alimentary tract, increase the mortality.

11. In cases of cholangitis, carcinoma of the pancreas or biliary passages, and suppurative hepatitis, the mortality is nearly 100 percent. The high mortality in these cases cannot be ascribed to the operative procedure, but is due to the too long-continued medical treatment or to the nature of the affection.

12. Early operation affords the best chances of lowering the percentage of fatalities.

Cook's Method for Drainage of the Gallbladder.—A simpler method for drainage of the gallbladder after cholecystostomy is the one devised and practised by George J. Cook. It is performed as follows:

The drainage-tube employed should be of large caliber and possess firm walls so as to be not easily compressed. Its proximal end is firmly fixed in the gallbladder by a purse-string suture. Its distal end should not project more than one and one-half to two inches beyond the edges of the wound. To this end is firmly tied an extra large and extra thick condom or rubber sac. The gauze dressings are next applied; upon these is placed the condom or rubber sac, and this is well surrounded and covered with cotton. All are retained in position by a binder bandage snugly adjusted. It can readily be seen that by this method we have produced an artificial gallbladder and it lies in close proximity to the gallbladder which is to be drained. This so-called artificial gallbladder is removed once or twice every twenty-four hours, emptied, and thoroughly cleansed, after which it is again placed in position.

After the fourth to the sixth day the tube and iodoform gauze may be removed, and if there is no obstruction of the gallducts, the fistulous tract may now be permitted to heal by granulation. One of the greatest drawbacks to the open method of treatment is the time required for the wound to heal, six to eight weeks being usually necessary.

After-treatment.—Following operations on the gallbladder or bileducts considerable pain and nausea and vomiting for several hours are common. Hence nothing but small quantities of hot water should be given by the mouth for twenty-four hours; a hypodermatic injection of morphin and strychnin may be advisable immediately after the operation, with rectal feeding for a few days. Attention to the bowels and fluid diet are practically the same as have been referred to under laparotomy.

When the common duct has been incised or the gallbladder opened, the dressings should be changed frequently and dry sterilized gauze applied at each dressing. The sutures are removed in due course and the drainage-tube is dispensed with as soon as the fistulous tract appears to be sufficiently sound. This will probably be at the end of a week or ten days. The sinus should be frequently washed out and the parts kept scrupulously clean. The fistula usually closes without complication in from three to four weeks. In many instances, how-

ever, it remains patent for months or years. Mayo reports that a few patients upon whom a cholecystotomy has been performed suffer from slight colic and sometimes transient jaundice during the first month or two after discharge from the hospital. These symptoms he considers due to the inability of an adherent gallbladder properly to empty itself. In most cases no secondary operation or special treatment is required.

For persistent biliary fistula the fistulous tract should be firmly packed daily with 5 percent iodoform gauze dipped in balsam of Peru, over which a firm compress is applied, or if granulations appear sluggish, silver nitrate may be used. Though often very slow in healing, a permanent fistula is rare, except when the gallbladder has been wrongly attached directly to the skin, in which case a slight resection of the parts usually becomes necessary before healing will result.

ABSCESS OF THE LIVER.

Postoperative Treatment.—The postoperative procedure suggested by Thomas L. Rhoades, U. S. A., has proved of such marked satisfaction in our hands that we give in detail his method of after-treatment, as well as that portion of the technic essential to a proper understanding of the same.

The liver being exposed, taking for granted that no adhesions exist between it and the diaphragm, narrow strips of sterile gauze are packed snugly all around the incision through the diaphragm, and between it and the upper surface of the liver, thus walling off the peritoneal cavity. No attempt is made to suture the nonadherent liver to the diaphragm, for the gland is too friable to retain sutures of any material, and in the several cases in which this was tried all the sutures tore through the tissue immediately on a slight amount of tension being used to approximate the two surfaces.

That part of the liver is now exposed for operation, and bounded by the gauze strips, should be as low down as the location of the abscess will permit, to allow for subsequent liver contraction and the relative change of surface levels—a consideration in the final stage of drainage. The liver is incised with a knife, a closed clamp is pushed through the intervening structure into the abscess, is opened, and withdrawn. The patient is turned gently on his back to facilitate the flow of pus, and when this has ceased, the cavity is examined and cleansed. Strips of gauze and a firm drainage-tube of large caliber are passed into the cavity, the tube being anchored on the skin-surface by a stitch, and

knots of white and black sterile silk are used to mark the ends of the gauze strips passing into the liver, and those packed around the opening through the diaphragm. These ends are brought out of the wound at the posterior angle, alongside the rubber tube; several additional strips are packed in the wound superficially to retain an opening through the chest wall at least 5 cm. in diameter, and the remainder of the skin flap is sutured in position with silkworm-gut. The dressing will consist of two parts: A single pad of sterile gauze for the exploratory incision, covered over with sterilized guttapercha or oiled silk, the edges of which overlap the gauze pad and become glued to the skin; and a generous arrangement of gauze and cotton pads built around and over the ends of the gauze drains and tube. A single broad binder from axilla to pelvis retains the whole in position. Time for both operations —exploration and rib resection—forty-five minutes.

After-treatment.—Judicious management of the postoperative period is most important, for on it will depend the ultimate outcome of the case. Individual methods of handling conditions differ widely, and that surgeon will secure the best results who adheres to methods, medicaments, and food-stuffs found most reliable under similar conditions in years of experience.

My general plan is to administer morphin sulfate $\frac{1}{4}$ grain and atropin sulfate $\frac{1}{200}$ grain to the patient after consciousness has returned, to allay pain and combat shock. If much blood was lost during the operation, saline transfusion will have been given on the table; and if shock is deep, application of dry heat and an enema of 250 c.c. of hot coffee will control it. Hot tea, which is acceptable to the stomach and dissipates the ether more rapidly, is sipped about four hours after returning to bed. Later in the day and on succeeding days, especially if there is nausea or vomiting, iced ginger ale, lemonade, albumen-water, or a sherry cobbler may be taken as beverages.

Free discharge will necessitate change of dressings about eight hours after operation, at which time the entire dressing is removed and clean gauze and cotton are reapplied, the patient remaining in bed. On the following five days the dressing is changed twice a day, the patient being lifted into a rolling litter and taken to an adjoining room each time, so that bed-linen and mattress can be changed and aired. On these occasions the new dressing is applied after washing off the skin-surface with water and alcohol, but the drainage is not disturbed. During the first six days, the time when fibrous adhesions are forming

between the surfaces around the gauze packing, the patient is kept mildly under the influence of an opiate—either morphin sulfate, $\frac{1}{8}$ grain, or Dover powder, $\frac{1}{2}$ grain, morning and afternoon—to promote restfulness and allay pain, but not in sufficiently large dose to act as a hypnotic. Effects on the nervous system in each case will determine the dosage. On the sixth day adhesions will have formed, and the gauze drainage and rubber tube will be surrounded by a fibrinous exudate and lymph, which, on removal of the drains, will have established a secure pathway from skin-surface to abscess-cavity. The gauze strips and rubber tube can therefore be removed with safety. The ends of the gauze projecting from the wound are clamped on forceps, and by twisting and tugging are removed in separate pieces. The tube is likewise withdrawn. With the aid of a stout, bent glass tube having a lumen 0.5 cm. in diameter, the cavity is irrigated with warm sterile water until the flow returns clear. A new rubber tube, similar to the one removed, is carried into the cavity, the depth of insertion being regulated by a sterilized safety-pin transfixing its external end. Strips of sterile gauze are packed around the tube down to the abscess cavity, dressings are applied, and the patient is returned to bed. This process is continued on each successive day, a clean tube and new strips for drainage being inserted after irrigation, until there is no further evidence of pus; all packing and drainage are then discarded, and the sinus is allowed to close. The patient is permitted to sit on a rolling chair in a reclining posture after the second week, and during the last days of local treatment will be walking about—providing, of course, systemic conditions are favorable.

Anemic patients about ten days after operation are given thrice daily on an empty stomach 30 c.c. of pure olive oil in a wineglass, into the bottom of which is squeezed 10 c.c. of lemon-juice. The oil should be of pure variety, the product of the press when the fruit is nearly ripened, so as to lessen the tendency to nausea. This amount can be increased to 60 c.c. or 90 c.c. three times daily in the course of a week, without causing any gastric disturbance, which dose is then continued for weeks until all evidence of dysentery has disappeared, a time which is necessarily variable. Patients soon acquire a taste for the oil, and those to whom it was distasteful at the onset of the treatment have later been seen to crave it. Under its influence they gain rapidly in weight, color, and vigor. Patients reduced to the neighborhood of 90 pounds and who were bedfast for months, have increased in weight from 40

to 50 pounds in six weeks' time, taking daily walks in the open air. The effect on the intestinal dejections is the most notable feature of the treatment. The oil acts beneficially principally by stimulating the portal circulation, increases the flow of bile, restores a natural digestive agent and antiseptic to the intestinal canal, and, combined with the bile, protects and promotes healing of the ulcers.

Feeding is an equally important matter, and at the beginning of convalescence, a proper dietary must be selected which will build up the patient, increase his powers of resistance, and while generous in quantity must not overwhelm his digestive powers. Milk and all articles of food prepared with milk (soups, gruels, etc.) are proscribed. The diet on which these patients thrive best, and gain most rapidly, is one of solid food, given in conjunction with the administration of olive oil. Salads and shellfish are usually most grateful, and, together with minced meats and well-cooked vegetables, constitute the most desirable dietary.

GASTROTOMY, GASTROSTOMY, PYLORECTOMY.

General Remarks.—Many forms of incision have been advised and carried out. Some have employed an incision in the median line, others a vertical incision in the left linea semilunaris. Sédillot used a cross-cut below the xiphoid cartilage. Howse prefers a vertical incision in the sheath of the rectus, a little to the inner side of its outer border. The vertical fibers of the rectus are exposed and are separated (not cut) with the handle of the scalpel. The posterior part of the sheath is thus reached. It is divided vertically, and the abdominal cavity opened. The incision has the disadvantage of bringing the wound area somewhat closer to the pyloric region. In carrying out the incision it should be remembered that, owing to the emaciation of the patient and the sunken condition of the abdomen, the part of the abdomen attacked is—as the patient lies upon the back—almost vertical. The integument, after passing over the margin of the ribs, turns suddenly backward toward the spine, following the sunken abdominal wall.

In gastrostomy several methods have been "invented" of fixing the pouch of stomach obliquely through the abdominal wall and then opening the extreme upper end of this tubular process, a catheter being secured in the usual way. They cannot be described here, but

the postoperative treatment applies to all. The many different methods adopted of feeding the patient only serve to emphasize the fact that no rigid rule can be adhered to, and that this factor in the after-treatment must be modified according to the particular circumstances of each case.

Feeding of the Patient and After-treatment.—The amount of food introduced on the occasion when the stomach is opened must depend upon the patient's condition. If no food has been swallowed for a considerable period, it will suffice at first to introduce only a few drams of milk mixed with a little brandy. The quantity can be gradually increased. If, however, the patient has been able to take some food through the gullet up to the time of the operation, his first meal may consist of from two to four ounces of a mixture of milk, egg, and brandy. This is slowly poured in through the funnel, the gauze covering of which prevents any semisolid particles from entering and blocking the tube. A pad of soft gauze packed around the aperture in the stomach will absorb any fluid which may escape. As a matter of fact, however, such escape is very seldom to be anticipated.

After the feeding the tube is left in place. It is secured to the ribs in the form of a coil by means of strips of plaster. Its end is left open, and serves to afford escape to any fluid which the stomach might attempt to reject. This open end is received by a pad of absorbent wool or the tube may be closed in the intervals of feeding by a light clamp. The skin around the margin of the "stoma" is kept clean and dry, is smeared with lanolin, and well dusted with sodium bicarbonate.

The feeding should be repeated frequently; the amount given is slowly increased, but the quantity administered each time should be small.

The diet will consist of milk, eggs, beef-tea, soups, tea, cocoa, certain prepared foods, and a proper allowance of water. All food administered should be of the temperature of the body. As time advances, more food may be given, but at less frequent intervals. The fistula may in process of time become enlarged, and then very finely minced meat and pulped vegetables may be introduced into the stomach by means of a suitable syringe. On the other hand, a tendency to contract is sometimes shown, and must be overcome by occasional dilation with a seatangle tent. The patient's own feelings afford the best guide to the value of certain foods and the amount and mode of their administration. It will often be found that the patient after gastrostomy is able to swallow with greater ease for a time.

Leakage of gastric juice and regurgitation of food are often due to the stomach having been opened too near to the pylorus. The patient who is the subject of such trouble should be fed in the recumbent position, and lying upon the left side. Leakage may also be due to the gastric opening having been made too large.

The irritation produced by the escape of gastric juice is best met by constant attention to cleanliness, by the very frequent changing of dry absorbent pads, and by the liberal powdering of the part with sodium bicarbonate.

OPERATIONS UPON THE INTESTINES AND USE OF THE MURPHY BUTTON. (MURPHY.)

The Murphy button should be used only for end-to-end or end-to-side approximation in the small intestines, an end-to-side or side-to-side approximation of the large intestines, as well as side-to-side approximation of the jejunum or duodenum to the stomach. For a gastroenterostomy Murphy prefers the posterior operation and the oblong button. In the stomach it prevents subsequent closure. One of the important factors in either method of approximation, particularly in acute intestinal obstruction, is to remove a number of inches or even feet of the bowel on the proximal side of the occlusion. The bowel in this condition is often infiltrated, ulcerated, or bordering on necrosis, and unless a sufficient extent is resected, there will be a failure of union, no matter what method is employed. In acute obstruction the contents of the bowel above the obstruction should be allowed to flow out at the time of the operation. When much work or manipulation is done in the abdominal cavity, particularly with bullet wounds, drainage should be instituted and the patient placed in a sitting position. The abdomen should never be flushed. Excess of sponging, packing, and manipulation of the intestines increase the danger of shock and infection.

After the use of the Murphy button liquid nourishment is administered eight hours after the patient recovers from the effects of anesthesia. This nourishment does not include milk; and no solid food is allowed until the button passes. Morphin is practically never used after laparotomy in Murphy's work. In a general way the after-treatment corresponds with that employed after gastroenterostomy, with a difference that food is given by mouth a little earlier, and that active cathartics are not given until the button is passed. If the colon is in-

volved in the operation, predigested foods are given by mouth from the third day on, but nourishment by enema is not employed. One can easily choose a predigested food which is absorbed almost entirely from the stomach, which will sustain the patient until the union between the united ends of the intestine is sufficiently safe to make use of a general diet. Ordinarily, firm union exists after the third day, but many patients in whom these operations are indicated are much reduced in strength, and consequently their tissues do not heal so rapidly; and in such conditions alcoholic stimulants are imperative.

FIG. 62.

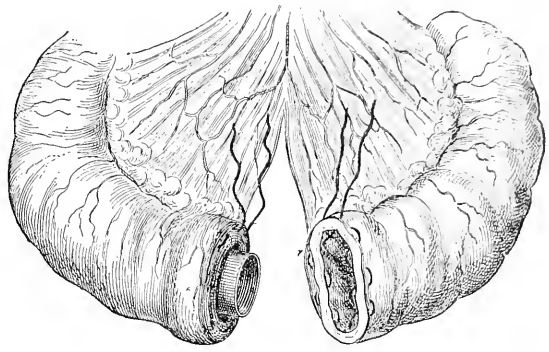

FIG. 63.

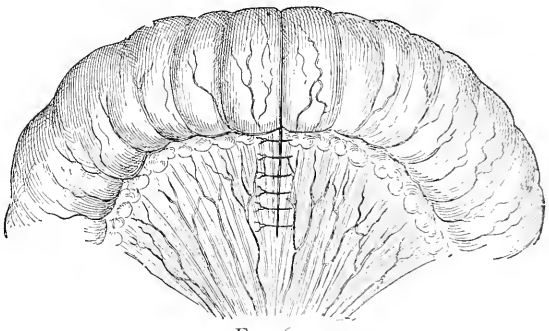

FIG. 64.

FIGS. 62 TO 64.—END-TO-END APPROXIMATION WITH MURPHY BUTTON HELD IN POSITION BY PURSE-STRING SUTURES.—(*Binnie, after Da Costa.*)

The length of time the button may be retained in the intestinal canal varies greatly. It usually passes in seven to fourteen days. In some cases several weeks may have elapsed before it appears in the rectum. Its presence and position in the abdomen can, of course, be ascertained by skiagraphy. When the button remains in the intestine, unless it is giving manifestations of irritation, which it rarely does, it should never be disturbed. It can usually be found situated in the rectum, just above the internal sphincter, after seven to ten days, and when it can be felt by digital examination it is extracted with forceps.

COLOSTOMY.

Considerations of Technic.—The operation of colostomy for the purpose of establishing an artificial anus is performed in two ways. The most common practice is as follows: The colon is drawn out through an incision in the abdominal wall, its mesentery split, and a flap of skin is cut and drawn through the slit in the mesentery and sutured in place. The upper segment of the intestine is then drawn outward

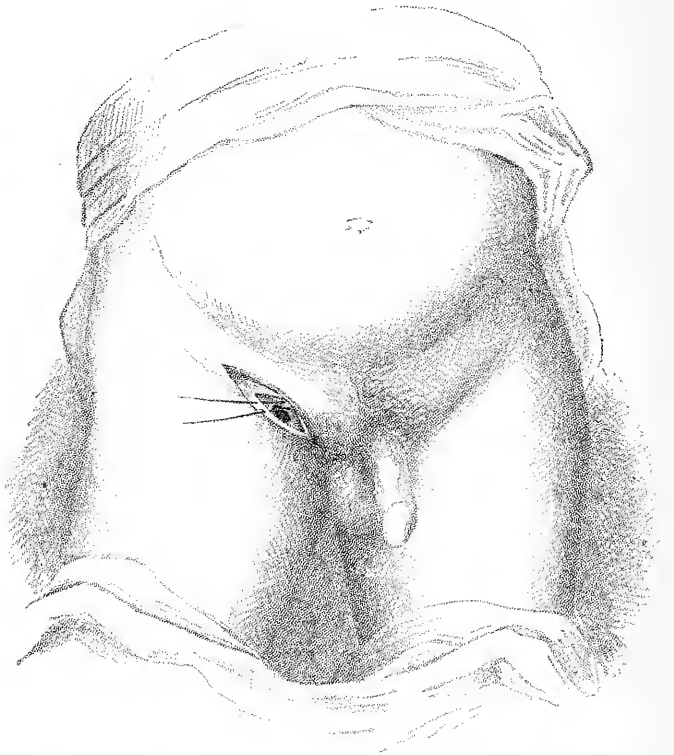

FIG. 65.—MACEWEN'S SUTURES TO DRAW THE CONJOINED TENDONS TO POUPART'S LIGAMENT.—(*Moullin.*)

and the lower segment placed inward, and the skin-flap drawn through the opening in the mesentery. In this manner the upper segment is bent over the outer edge of the abdominal wall and underneath the skin-flap; consequently after healing has taken place the application of a pad over this part will cause the skin-flap to act like a valve and prevent the voluntary evacuation of the bowels. In order to prevent protrusion,

several stitches are inserted, attaching the intestine to the skin. The loop of the intestine is not opened until adhesions have formed, unless this is necessary on account of complete obstruction, in which case the wound is carefully protected and a large rubber tube covering a short glass tube is inserted into the upper segment and securely fastened by means of a strong purse-string suture. This will compel the contents of the intestines to pass out through the tube which passes through the center of the dressings without soiling the wound. If immediate opening of the intestine is not necessary, the part should be covered with sterile gauze held in place by means of broad adhesive strips and abdominal bandages. After three to five days when adhesions have thoroughly formed the intestine may be opened, and evacuation of the bowel can now occur without interference with the healing of the wound.

Another method is to draw the intestine purposely through a thick part of the abdominal wall by bringing it out obliquely rather than directly through the tissues, by choosing the muscular part so that the muscles by tension and contraction may keep the gut closed, and only give under the pressure and force exerted by the peristaltic contraction of the intestine. The intestine is now carefully sutured in position and allowed to granulate for forty-eight to seventy-two hours, after which delay the bowel is opened transversely to its long axis so that the upper end shall evacuate its contents externally directly through the opening. If the artificial anus is to be but temporary, it is probably best to make the opening in the long axis of the gut rather than transversely. Some surgeons—Hartman and others—do not suture the intestine at all, but merely pull out the gut, packing a piece of iodoform gauze carefully around it and over both ends, leaving it there for eight hours.

After-treatment.—Ochsner states that until the protruding loop has been cut only hot water and small quantities of predigested food are given by mouth. After this general liquids, and after a week light diet, are given.

This operation is usually performed in old persons greatly reduced in strength, and these do not bear lying quietly in bed. It is consequently best to permit them to occupy a semisitting position within a day or two after the operation and to leave the bed within a week or ten days later. After the intestine has been opened a cathartic, preferably castor oil, should be given, and this should be followed by several enemas in order to remove fecal accumulations which frequently exist

in large quantities above the constriction, even if a diligent attempt has been made to evacuate the bowels before operation. Frequently the lower segment contains many of these masses, which can usually be removed by irrigation, but may occasionally require a blunt scoop for their removal. It is well to examine the opening by inserting the finger within the lumen of the intestine through the abdominal wall, because occasionally not sufficient space has been allowed for the evacuation of the bowels and the free passage of gas. This can be remedied readily by a slight incision.

These patients should be instructed to regulate their diet so as to avoid constipation, and then to take a simple cleansing enema once a day to insure a free evacuation of the bowels. Thus they can usually be entirely free from any annoyance because of the artificial anus. A small pad of cotton should be worn over the opening, held in place by a simple abdominal bandage. In case there is any annoyance from escaping feces a substantial pad may be held in place over the opening by means of an elastic bandage which will compress the intestine underneath the skin-flap.

If there is not enough force in the colon to effect an evacuation, it is sometimes best to insert a large rectal tube after giving the enema and to effect the evacuation through this.

Postoperative Treatment as Recommended by Sir Frederick Treves.—When the symptoms are not urgent, the operation of colostomy is usually carried out in two stages (*colostomy à deux temps*). The bowel is fixed to the skin by numerous superficial sutures. Care should be taken that no suture extends through the mucous lining of the bowel. The part is well dusted with iodoform, and after an interval of thirty-six to forty-eight hours the operation is completed by opening the colon.

After-treatment.—The actual wound is dusted with iodoform, and all the skin around is well covered with lanolin. A large pad of absorbent wool is placed over the artificial opening, and retained by means of a many-tailed bandage. So long as there is a copious escape of fecal matter no bandage should be applied. The pad of wool must be changed as often as it is soiled, and the exclusive attention of one nurse should be occupied in keeping the patient always clean.

When the discharge is very free, a pad of loose "tenax," covered with a layer of wool, will be found to be more convenient. The main feature in the nursing is that the part must be kept dry. The skin

should not be rubbed clean, but should be cleansed by a stream of warm water, which is received in a kidney-shaped tray. This method involves no more trouble and no more time than the patting and rubbing process which is carried out with innumerable pledgets of cotton-wool. After each washing the skin is very gently dried, and is once more covered with lanolin. If the wound were to need washing every fifteen minutes during the first day or so, it would certainly be better to do so than to allow a freshly united incision to remain for an hour or more poulticed with fecal matter.

During the first few days the patient should keep very quiet, should lie upon the back, or, if the position be altered at all, should turn over toward the wounded side. The attachments of the gut will be dragged upon if the patient lie upon the sound side. The discharge of fecal matter from the bowel may be delayed for hours or even for days. The opening, as already stated, is at first very small; and if it suffices, well and good. If, however, hard scybala have to escape, then the opening must be in due course enlarged. An aperient given on the fourth or fifth day after the operation has often an excellent effect.

Prolapse of the gut at the artificial opening is, so far as my experience goes, but rarely met. A preliminary small opening in the gut, primary healing, and the maintenance of a healthy condition of the mucous membrane appear to be the main factors which assist in preventing this complication. The skin around the artificial anus may become very raw and inflamed. This is especially likely to be the case when the fistula is established near a malignant growth, as when the colon on the right side is opened. In these circumstances a frequent washing-out of the bowel, and the most scrupulous attention to the cleanliness of the part, will effect much.

Properly shaped pieces of lint soaked in oil may prevent some of the fecal matter from running over the skin, but no contrivance that I have as yet seen has prevented it entirely. The disturbing symptoms produced by the presence of fecal matter in the colon below the artificial opening may be relieved by the systematic washing-out of that part of the bowel, and by the subsequent closure, if need be, of its upper extremity.

The diet in these cases should be spare and nourishing, and of such a kind as to leave the least possible residue in the intestine. The consumption of milk in considerable quantity appears to encourage the formation of scybala. A liberal amount of vegetable matter should be a feature in the diet.

After the wound has healed and the recovery from the operation is complete, the patient may be furnished with a simple belt which will permit a pad of wool or some folds of linen to be held in place when the patient is moving about. The simpler the belt, the better; and it must be so constructed as to be readily unfastened. The various plugs, cups, bags, and pessaries which have been devised for the use of patients after colostomy are, so far as I have seen, more or less useless. After a short trial they are usually abandoned for some simple arrangement of cloths or pads which the patients have themselves devised.

Colostomy for Acute Obstruction.—In cases of acute obstruction of the bowels when the patient is greatly exhausted we have found the method of rapid or temporary colostomy, as devised or practised by Franklin H. Martin, to be not only very simple, but highly satisfactory, affording rapid relief to the patient. A small abdominal incision is made under local anesthesia. A loop of distended bowel is pulled through and out; a piece of gauze is passed between the skin and the bowel through its mesentery. A small incision is made into the bowel and a portion of the Murphy button hastily inserted and attached to the intestinal wall. The other or outer end of the button, having been previously covered by a piece of rubber tubing, is rapidly pushed home, the discharges from the bowel being conveyed into a pus-pan or vehicle. Since much time is usually lost in an effort to determine which is the upper or lower end of the bowel, no effort is made to determine this question at this time. Later, when the button comes away, the direction of bowel movement can be easily determined, and by this time the patient, having recovered strength, a laparotomy can be made with safety, and the obstruction removed if present, or an end-to-end approximation may be made and the bowel dropped into the abdominal cavity. This operation is essentially an emergency one.

INTESTINAL OBSTRUCTION.

Concerning after-treatment Nicholas Senn says: Uniform equable support of the abdomen, by strapping and bandages over the antiseptic absorbent dressing, furnishes efficient support to the distended abdominal walls and the paretic intestines, and is not only grateful to the patient, but is an important aid in relieving the distress due to distention and peristalsis. In all operations for intestinal obstruction

efforts should be made to empty the bowel, not only at the seat of obstruction, but so far as it can be done throughout, as such immediate evacuation constitutes one of the elements of success.

J. Greig Smith states that "no case of operation for intestinal obstruction is properly concluded until the distended bowels are relieved of their contents." One of the most favorable symptoms after a successful operation for intestinal obstruction is a spontaneous action of the bowels, as it not only proves the permeability of the intestinal canal, but is also an evidence that peristaltic action has been restored. The retention of fecal material in the distended paretic intestines after operation for intestinal obstruction is a condition that not only retards recovery, but is in itself a grave source of danger. Through the sympathetic nerves the distended intestine exerts a most depressing effect on the cerebrospinal centers, while the putrefactive changes that are constantly going on in the stagnant intestinal contents must be a constant source of intoxication, and, at the same time, the migration of septic microorganisms through the paretic walls threatens life from septic peritonitis.

Symptoms of shock are met by the administration of strychnin subcutaneously, stimulants by the rectum, intravenous or subcutaneous saline infusions, and stimulation of the peripheral circulation by dry heat applied to the surface of the trunk and extremities. Mr. Tait has taught us the value of cathartics in the prevention of peritonitis after abdominal operations. Would it not be rational to follow his example in the after-treatment of operations for intestinal obstruction? Surgeons have repeatedly made the observation that the paretic intestine above the seat of obstruction will respond slowly but surely to mechanical irritation, and it is logical to conclude that the same effect would be produced by the administration of a brisk saline cathartic. Dangerous as the use of cathartics necessarily must be before the obstruction is removed, so beneficial may their judicious employment be after the continuity of the intestinal canal has been restored by operative treatment.

Feeding, etc.—Thirst is quenched by sips of hot water, fragments of ice, and saline rectal enemas. Stomach-feeding is absolutely contraindicated for the first forty-eight or seventy-two hours, during which time rectal alimentation is relied upon exclusively. Absolute rest in the recumbent position must be enforced until the visceral and abdominal wounds have healed. The administration of copious laxative

enemas is permissible for the purpose of assisting the saline cathartics to restore peristalsis, provided the seat of strangulation was above the ileocecal valve.

Postoperative Enterostomy.—Enterostomy for the purpose of feeding, or in cases of intestinal paresis, is to be recommended especially for temporary use, and it should be resorted to under none but urgent indications, the disadvantages of an intestinal fistula being manifest. The operation requires but a few minutes and is readily performed under local anesthesia.

The technic of the operation varies somewhat, depending upon whether it is primary or secondary to another operation, or whether the fistula is to be used for feeding alone or for drainage as well. If for the purpose of feeding only, the method introduced by Witzel for gastrostomy is perhaps the one to be chosen. R. Follis, Resident Surgeon of the Johns Hopkins Hospital, has reported a method for the production of a temporary intestinal fistula which we believe offers an advantage over any other with which we are familiar, in that the intestines may be opened immediately with less risk of soiling the peritoneum. These fistulas generally close spontaneously.

We have generally proceeded as follows: The selected loop of bowel is brought out and iodoform gauze is packed around it to wall it off from the general peritoneal cavity. This loop may be opened immediately, or if the patient's condition admits of delay, sufficient time may be allowed for the formation of protective adhesions. After the opening has been made a rectal tube is inserted, first in one direction and then in the other, and may usually be passed several feet either way. This will allow the escape of gas and feces from the distended bowel, and through it, when necessary, a considerable segment of the intestine may be irrigated. So soon as the intestine has been opened and the tube is inserted we generally inject a quantity of salt solution in both directions, and by watching can usually determine which is the distal portion. After the distal segment has been determined, one can begin at once the administration of stimulating or nutritive enemas through the fistula. The amount of fluid that can be given in twenty-four hours and retained is surprisingly large. Water or coffee infusion, peptonized milk, eggs, and prepared foods in any desirable quantity can, through the tube, be placed in the intestine several feet from the opening, and by gravity or hydraulic pressure be forced onward into a collapsed, atonic bowel. Purgatives, such as castor oil, salts, croton

oil, calomel, or, in fact, anything that the normal stomach will tolerate, seem to be well borne. Generally in favorable cases peristalsis becomes quickly reestablished, and the fistula closes spontaneously or can be closed by operation.

In abdominal operations in which the immediate necessity for the establishment of a fistula does not exist, and yet in which the operator has reason to fear that the operation may later become indicated, it is well before closing the abdomen to determine the loop of intestine in which the opening can be most advantageously made. This loop should be fixed by the gauze packing in order that it may be readily accessible for subsequent manipulation. Guide sutures should be inserted into the bowel wall at the point to be opened. These may be taken out without harm at any time later and the gauze removed, if it is found unnecessary to incise the bowel.

Postoperative intestinal fistula once established should be looked upon more as a mouth than an anus. It should be used for irrigation of the intestinal canal, for the nourishment of the patient, and for the introduction of cathartics. We have often noticed that food introduced into the intestinal canal through the fistula had of itself a stimulating effect upon the peristalsis.

CHAPTER XI.

LAPAROTOMY AND OPERATIONS UPON THE ABDOMEN.

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Postoperative Treatment of Operations Upon the Abdomen.—In all laparotomies, whether the operation is to be on the stomach and intestinal tract, uterus, or ovaries, the stomach and intestines must be emptied, the former by means of lavage, the latter by laxatives. As laxatives increase the number of bacteria, they should not be given later than two days before the operation. The food must be such as will not result in the formation of fecal matter. Soups, vegetable or animal, gruels, but no milk, with an abundance of fluids, are the usual routine. Two days before the operation betanaphthol bismuth or acetozone should be given, to limit as far as possible the fermentative changes in the intestinal contents. When the diet is very limited, opium should be given.

Immediately following all laparotomies, and usually before the patient is removed from the operating table, if there has been any considerable loss of blood, or if the patient be apparently delicate in nature or of neurotic temperament, a high rectal enema of normal salt solution should be administered, the solution being at a temperature of 108° to 110° F. If there seems to be a lack of tone or a general depressed condition, hypodermatic injections of nitroglycerin, strychnin, and digitalin should be promptly given.

Gruzdeff has long advocated copious flushing of the abdominal cavity with saline solution before closing it after a laparotomy. In 28 cases in which the abdomen was treated by the dry method there were 3 deaths, while only one patient died in the 72 cases in which he followed his method of irrigation, and this fatality was due to other causes. He prefers Locke's solution for the purpose, as more nearly approximating the composition of the blood-plasma, and pours it into the abdomen three or four times, swabbing out the cavity each time with gauze sponges, and finally leaving a large amount in the abdomen after it is sutured. He thinks by this means the abdominal cavity is not only cleaned, but the germs that may have found their way in dur-

ing the operation are washed out and the phagocytes are stimulated to more energetic action. A still further advantage is that the pressure in the abdomen is maintained by the fluid left behind, and it does not tend to collapse after the removal of large tumors. If symptoms of pronounced shock are present, the treatment should be energetic, as heretofore described. (See page 83.) Patients who are allowed to go for several hours with a subnormal temperature and high pulse are with great difficulty restored. (Martin.) In all aseptic cases the wound itself requires little or no attention for several days, and the dressings about the wound should not be disturbed unless symptoms of infection supervene, as announced by rising temperature, high pulse-rate, and general restlessness. After nine to fourteen days the wound should be carefully examined and the stitches removed, after which small strips of sterile adhesive plaster should be applied to support and prevent spreading of the scar.

Care of the Bowels.—If flatus has not passed freely from the rectum in twelve hours by the simple employment of a rectal tube, a rectal enema of one ounce of magnesium sulfate, two ounces of glycerin, and three ounces of water should be given. If there is no bowel movement or if the retention of flatus is obdurate, one-half grain doses of calomel with or without sodium bicarbonate should be given every two hours until four to six doses are given, or until gas passes. If necessary, the calomel may be given alternately with dram doses of Rochelle salts, magnesium citrate or sulfate, in an ounce of water. If the stomach is very much irritated and will not tolerate calomel, after lavage with a solution of boric acid and before the stomach-tube is removed one ounce of castor oil should be administered. The cases are very few that will not yield under these remedies. For more persistent cases or postoperative complications the reader is referred to matter as heretofore described under special headings.

Drainage.—When the glass drainage-tube is allowed to remain in the abdominal wound, it should be gently emptied in one hour by a syringe with a long rubber nozle. If the fluid is more than two or three drams, it should be dressed again in an hour, or if the fluid is less than a dram, the intervals between dressings should be increased. The tube is usually removed in twenty-four hours. If, however, after this time drainage seems necessary, a small piece of sterilized gauze may be inserted in place of the glass tube, and allowed to remain six to twelve hours, after which the wound is closed by ordinary sterile

adhesive strips. If capillary gauze drainage has been employed instead of a glass tube, the protruding gauze should be abundantly covered with a pad of loose, fluffy gauze, and this should be changed as often as it becomes saturated with fluid. If all drainage ceases in twelve to twenty-four hours as indicated by dry dressings, the gauze packing, if loose, may be removed. However, if drainage is free and the patient is normal in condition, the gauze may remain forty-eight to sixty hours, and after its removal a loose gauze packing should be placed over the wound.

Urine.—The patient should always be urged to pass urine voluntarily and the catheter should not be resorted to unless absolutely unavoidable.

General Remarks.—So soon as possible after anesthesia hot water or hot tea in teaspoonful doses may be given as often as every fifteen minutes if the patient is extremely thirsty. If the stomach tolerates this, the quantity is increased to half an ounce every half-hour. When the patient cannot take hot water and complains of intense thirst, the nurse is instructed to let him rinse the mouth with cold water. After twelve hours, if the patient's condition is such as to demand nourishment, peptonoids or peptonized milk may be substituted; later, fluid nourishment, bouillon, broth, or thin gruel, may be substituted, so that by the third or fourth day the patient will be able to take the extracts of beef, shellfish broth, etc. Orange-juice and the juices of other ripe fruits are often greatly relished, and may be used in small and oft-repeated quantities. If stimulants are required, whisky is the best, or champagne may be used. If patients are unable to retain sufficient food by the stomach to nourish them properly, nutrient enemas as heretofore described should be resorted to. Uncomplicated laparotomy cases after the tenth day are permitted to sit up in bed with back-rests, and after the twenty-first day are allowed to be seated in chairs, but are not allowed to leave the hospital before the twenty-eighth to the fortieth day. (Martin.)

Laparotomy for Septic Conditions.—The surgeon frequently finds himself forced to operate after diffuse peritonitis from ruptured pus-tubes, appendix, or other sources of infection, and these cases should be classed by themselves, and so far as after-treatment is concerned, they belong to a different category from aseptic cases. How best to proceed under the circumstances to save an apparently hopeless case is tersely stated by Kocher as follows: "As soon as the abdominal

cavity has been opened, the healthy regions of the abdomen should be shut off from the diseased parts on which the operation is to be carried out. This should be done by packing with gauze. The introduction, through a sufficiently large external wound, of hot, sterile, soft gauze compresses, wrung out of an 8 percent salt solution, so as to shut off the field of operation, insures against the harm which results, especially in septic cases, from the escape of gastrointestinal contents, bile, urine, or infective inflammatory products.

"Avoid any antiseptic and any possibility of injury to the peritoneum by cooling and evaporation. No small praise is due to Tavel and his pupils for having demonstrated experimentally the nature of this deleterious action, and for having rendered its avoidance possible. On the basis of their researches we were probably the first to employ (chiefly in laparotomies) only physiologic salt solution at the body-temperature and to keep all exposed peritoneal surfaces constantly moist and warm by irrigation, or by applying compresses and guttapercha tissue over them. Complete removal of every source of infection and drainage of infected areas, combined with their isolation by tampons in the form of gauze strips impregnated with a fixed antiseptic, as recommended by Mikulicz, is necessary. As iodoform has such a toxic action on the peritoneum, xeroform or some other nontoxic antiseptic should be preferred.

"Prevention of any collection of blood or effusion into the wound by most careful arrest of hemorrhage, no matter how long the time required to effect this, and by careful suture of every injured surface of the peritoneum, is required. This is a most important point, and it was only when attention was paid to it that the intraperitoneal treatment of a uterine stump was rendered safe.

"Tietze showed by his excellent experiments that the omentum could be safely employed for covering over necrotic areas in the stomach or intestinal wall. Braun and Bennet even closed defects in the stomach with omentum only, which formed firm adhesions to the surrounding serous membrane. The inner surface of the omentum gradually becomes covered over with epithelium which grows in from the edges of the opening. Careful suture of every cut or tear in the peritoneum, and complete closure of the main wound in every case when there is no question of draining away infective fluids, is essential."

Position of Incisions.—The only incisions in the abdomen which can be regarded as normal are the median, the transverse in the upper

part of the abdomen, and the oblique incision passing from above downward and inward in the lower part of the abdomen, because these incisions do not damage the muscles of the abdominal wall through their nerve-supply, and are in accordance with the principles which have been already laid down for all the normal incisions of the body. The above normal incisions can be very well used in combination, as, for instance, in splenectomy, or for carcinoma of the lowest part of the sigmoid flexure, when to the median incision a transverse incision may be added, varying in length according to the requirements. Assmy, at Czerny's instigation, showed that the longitudinal incisions through the middle of the rectus, which are preferred by many surgeons, cause atrophy of the median portion of the rectus if its motor nerves are interfered with.

Laparotomy in Cases of Peritonitis.—When an exudate which can be demonstrated clinically has formed in the peritoneal cavity, the only certain way of preventing extension of the inflammatory effusion is by early operation. When exploring the deeper parts in such conditions, it is quite unnecessary to use any other than the normal incision with splitting of the muscles.

According to McBurney's method, all circumscribed abscesses, both those with fluid contents and those in which there is merely a free inflammatory exudate, can in this way be thoroughly evacuated and drained through a small incision. Difficulty is first apparent in the treatment of peritonitis when numerous small or large abscesses surrounded by fibrous adhesions have formed in different parts of the peritoneal cavity. Many cases have been recorded of satisfactory results in so-called diffuse peritonitis, which, however, were not diffuse in the sense that the whole peritoneal cavity up to the diaphragm was involved, but which represented merely encapsulated inflammations occupying a large area of the peritoneum. There is only one certain means of dealing with such diffuse forms with numerous encapsulated foci of infection, and that is by prophylactic treatment. A circumscribed abscess may lead to multiple abscess-formation either by the spread of the infective material or by perforation, or, *a priori*, diffuse peritonitis with fluid exudate may lead to multiple suppurative areas by the pouring out of fibrin and the formation of adhesions. The only way to prevent this extension is to treat every attack of inflammation at its commencement on surgical principles, *i. e.*, to open and remove the infective material. In this respect the advocates of immediate

operation in early cases of perforated appendicitis are undoubtedly right, as a definite percentage of the cases in which expectant treatment is employed in preference to immediate operation must be lost from peritonitis. When an incision is at once made, as advocated by Bernays, Rehn, Deaver, and others, and the source of infection removed, although death cannot be avoided in every case, yet, as Bernays has proved, the results, if all the cases be taken into account, are better than those where expectant treatment is employed.

In peritonitis which is diffuse from the onset, with a fluid exudate, it is quite justifiable, after the cause has been removed, to make a median incision and to irrigate the peritoneal cavity thoroughly with physiologic salt solution at the body-temperature, for as long a period as may be required. For diffuse peritonitis with multiple encapsulated abscesses, not only between the intestinal coils, but also between the liver, spleen, and diaphragm, a long laparotomy incision is indicated, so that free access may be gained to all abscesses. But such a long incision is attended with danger from shock, the result of injury to the hyperesthetic peritoneum; it reflexly inhibits or paralyzes the vasomotor center, and, by a direct action on the abdominal vessels, increases the venous hyperemia in the abdomen, and with it secondary cerebral anemia.

In severe cases it often becomes necessary to empty the intestines by washing them out thoroughly through an opening above and below in order to prevent absorption of toxic products from the intestines, and to keep them empty by the administration of magnesium sulfate. Further, after the operation, hyperemia of the abdominal organs should be reduced as much as possible by proper posturing of the patient, combined with the application of ice and compression to the abdomen. A matter of great importance in the treatment of peritonitis is to drain off all inflammatory products and infective material. For this purpose the insertion of one drainage-tube is not sufficient. Each area of suppuration must be opened and drained. If this is done, it will be found unnecessary to irrigate in cases of diffuse multiple collections of pus, and the resulting shock is much less.

Postoperative Laparotomy for Peritoneal or Intestinal Adhesions.—Lauenstein emphasized the good results which can often be obtained in cases of severe pain and spasms in the region of the digestive tract by opening the abdomen and simply separating adhesions which fix the viscera to some particular spot on the abdominal wall, or which

link or bind them together. The importance of this condition has not been fully appreciated. The results of such an operation are often striking and immediate, and relief may be given from suffering which has existed for years.

A short time ago the author operated on a patient who was suffering from repeated attacks of acute abdominal pain attended with symptoms of collapse, so much so that the question of perforation was considered, more especially as there was a history of previous dysentery. Laparotomy was performed, and strong adhesions binding a portion of the small intestines to the lateral aspect of the abdominal wall were discovered and divided. The whole of the symptoms disappeared. The agony had been so intense that the patient dreaded taking food, and in consequence was very much emaciated. Recovery was complete.

No directions suitable for every case can be given. The adhesions must be completely divided in order to insure perfect freedom of movement of the viscera, and, where possible, large raw areas must be covered with healthy peritoneum or omentum. If it is correct that silk ligatures become permanent foreign bodies, and, therefore, liable to cause adhesions, preference must be given to catgut, which is easily absorbed.

Method of Preventing Postoperative Adhesions of Intestines.—Charles Cargile, of Bentonville, Ark., has made use of serous membrane for the purpose of preventing intestinal or abdominal adhesions following laparotomy. After a somewhat extended experience the Cargile membrane, as it is called, received the indorsements of Robert T. Morris, of New York, and John B. Deaver, of Philadelphia. At the suggestion of these operators this membrane has been prepared and made accessible to the profession through Johnson & Johnson. It is put up under the name of "Cargile Membrane," packed in strips about 4 by 6 inches, each piece sterilized and inclosed in a double envelop. The membrane is very soft, smooth, pliable, and transparent, producing no irritation, and adapts itself closely to the surfaces applied to. It is intended to act as a protective dressing to the denuded surfaces. It is nonirritating and is absorbed in from two to three weeks. More recently A. B. Craig, of Philadelphia, carried out a series of experiments on dogs, using Cargile membrane in an attempt to prevent peritoneal adhesions. After careful study and the reopening of abdomens at various intervals, he is of opinion that the membrane, for this purpose, is practically valueless.

The author has used in operating for umbilical hernia, where intestinal adhesions were most pronounced, a thin layer of carefully sterilized goldbeater's skin, which answers the purpose most admirably.

Operations on the Gastrointestinal Canal.—Whenever the alimentary canal is opened, septic influences have to be combated, for the gastrointestinal contents, under normal conditions, harbor a far greater number and variety of bacteria than does the skin. Our first care must, therefore, be to endeavor to limit the risk of infection to as small an area as possible. The means by which we seek to avoid these contingencies are various, and cannot be the same for every case. The method of preventing a spread of infection by means of compresses has been considered under the general remarks on laparotomy. But the protection of the immediate neighborhood from contamination depends chiefly upon whether the organ which has been opened can be entirely closed, as, for example, in Billroth's second method of pylorectomy, and in Kocher's method of performing resection of the pylorus, in which the stomach is completely closed after the removal of the neoplasm; or whether the opening which has been made has to be joined to some other part of the gut in order to form an anastomosis, as in gastroenterostomy and the various enteroanastomoses.

In all cases, and without exception in those in which the mucous membrane of the gut has been exposed, a thorough cleansing of the surrounding parts must be effected after the suture including all the layers has been introduced, and before the serous suture is applied, and if necessary, soiled swabs used in shutting off the field of operation must be replaced by fresh ones. The certainty of closure of gut or stomach always depends on the union of the peritoneum of both ends of the gut, but exact apposition of the mucous and muscular coats is worthy of more attention than has for some time been paid to it. If these layers are properly united, function is more quickly restored, and what is far more important, necrosis of the margin of the wound toward the lumen of the gut is avoided. Such necrosis rarely, but nevertheless occasionally, gives rise to phlegmonous infiltration of stomach wall; while more frequently it leads to formation of small foci of infection and metastatic inflammation, pneumonia, etc.

AFTER-TREATMENT OF ABDOMINAL SECTION.

Method of Sir Frederick Treves.—General Measures.—The patient must lie absolutely upon the back, and the knees may be kept a

little flexed by placing a pillow beneath them. A large cradle is placed over the trunk. It protects the abdomen from the pressure of the bed-clothes, and helps to ventilate the bed. The patient's body is covered by a blanket, which is placed beneath the cradle and in direct contact with the trunk. The rest of the bed-clothes are in two sets, so folded as to meet transversely in the center of the bed. They are placed over or outside the cradle, overlapping at its summit. This arrangement permits of the wound being inspected and dressed and enemas, etc., given without disturbing the bed-clothes that cover either the upper part of the body or the lower limbs.

The bed should be well warmed with hot bottles before the patient is placed in it, and hot bottles may be kept in contact with the feet and thorax for some time after the operation. The patient's movements should be restrained while consciousness is returning, and the nurse may support the wound with the hands during the first attack of vomiting. The less the patient is interfered with during the first twenty-four hours after the operation, the better. Morphin should be avoided whenever it is possible, and should never be given as a matter of routine. One-sixth of a grain is sufficient at a time. One injection only will probably be found to be sufficient.

The less taken by the mouth during the first twenty-four hours, the better. Nothing whatever need be given by the mouth for the first nine hours. The patient is then allowed hot water or hot weak tea in doses of half an ounce every half-hour or so. Ice is to be absolutely condemned. The reckless and immoderate sucking and bolting of lumps of ice, which are encouraged by the nurse who believes a patient is doing badly who is not constantly swallowing something, is most pernicious. The stomach becomes filled with cold fluid, and a sense of great faintness and discomfort persists until the melted ice is ejected by vomiting. If really distressing thirst is experienced during the first twenty-four hours, it is best relieved by an enema of warm water. No other form of rectal injection should be allowed. During the second day the patient may take hot tea or barley-water in small quantities, provided such nourishment does not cause vomiting.

A catheter should be passed when required. It will not be needed during the first twenty-four hours, and the sooner the patient can discontinue its use, the better. The practice of passing a catheter by routine once in so many hours is most decidedly to be condemned. As a rule, very little urine enters the bladder during the first twenty-

four hours after operation. Nutrient enemas are not needed except in very unusual cases attended with persistent vomiting. In a case that is doing well the diet from the third to the fourth day may consist of tea and toast, peptonized milk, malted foods, etc. Meat extracts and meat jellies of all kinds are to be avoided. Milk is not usually well borne, and leads to the formation of scybala, while the indiscreet perseverance in a slop diet often causes nausea and flatulence. What food is given should be given often and in small quantities. A little fish may be given on the fourth day, and meat on the seventh. Throughout the progress of an abdominal case patent foods are as much to be avoided as patent medicines.

The bowels may possibly act spontaneously. As a rule, however, they do not. In such circumstances an aperient followed by an enema should be administered on the third or fourth day. The aperient selected should be that which the patient is accustomed to take. Castor oil is much to be commended. The enema is most important for the purpose of clearing out the lower bowel. It may be repeated if there be any evidence that the rectum is not well emptied. The injection need not be copious; and in cases in which extensive pelvic adhesions have been dealt with, even small enemas often cause distress.

Flatulence or distention of the belly is frequently complained of at an early period after the operation. It may to some extent be relieved by the use of the "rectum tube." This consists in the vaginal pipe of an ordinary Higginson's syringe or a large soft-rubber catheter. The tube is passed about two or three inches into the rectum, and may be left there for ten or fifteen minutes, or so long as it appears to afford the patient relief. A small soap-dish must be placed under the free end of the tube, to receive any fecal matter that may escape. In these cases of flatulent distention minute doses of a carminative, notably of one of the aromatic oils, often have a very excellent effect, and the same may be said in a lesser degree of sal volatile and spirits of chloroform. A hypodermatic injection of strychnin ($\frac{1}{60}$ grain) is sometimes useful in overcoming intestinal distention. But probably the simplest and most efficacious measure is to turn the patient on the side for a time. This can often be done with safety, and affords relief to the backache so frequently complained of.

Now and then it will be found that about or before the seventh day after the operation—often about the fourth or fifth—the abdomen is distended, the tongue is coated and foul, the belly is tender, and

complaint is made of the tightness of the binder, while there may be a little vomiting or nausea. The temperature remains normal, the respiration unaffected, the complexion unaltered, and the pulse and general condition good. The symptoms in such a case may depend upon the fact that the bowels had not been well evacuated before the operation, or the intestine may have been partially paralyzed by too much opium, or the diet since the operation may have been such as to lead to tympanitic distention. The lavish use of meat extracts or concentrated meat preparations is very likely to be followed by great distention due to decomposition. The patient who presents these symptoms is often greatly relieved by a saline or other aperient. The bowel is well cleared out, and the sickness, pain, and distention vanish. It is possible that cases of this character, relieved in the manner indicated, may have been described as examples of acute peritonitis treated by saline aperients.

The graver complications after abdominal section—among which may be mentioned internal hemorrhage, peritonitis, septicemia, intestinal obstruction, fecal fistula, thrombosis, parotitis, and pulmonary embolism—must be treated according to the measures advised in the treatises on surgery.

After-treatment of the Wound.—The dressing may be removed on the fourth day. The wound should be kept dry. It needs no washing, nor to be touched with anything moist. The dried iodoform powder is picked off with sterilized forceps, and fresh iodoform is applied under a new dry dressing. The binder and thigh pieces are once more adjusted. The sutures should, as a rule, be left in for ten, twelve, or even fifteen days. In other words, a firm scar should have time to form before they are removed. The retention of the stitches will enable the operator to dispense with the subsequent use of strapping.

Throughout the whole period of convalescence the binder should be retained, and be always carefully applied. In cases in which the wound has become infected and fails to heal, or in which it has burst open after the removal of the sutures by reason of violent expiratory movements on the part of the patient, or in which the incision has been deliberately opened up by the surgeon, the margins should be kept well adjusted by means of strapping, which in such cases will require to be reapplied once, or possibly twice, in the twenty-four hours.

For the first fortnight after the operation the patient should lie upon the back and be kept as still as possible. At the end of this time

he or she may be allowed to be a little raised in bed, or to lie upon one side while the back is well supported with pillows. Between the third and the fourth week the patient may be allowed to get up. Such are the times which may be observed in an ordinary case of average severity. In a large proportion of instances it is well that the patient should remain in bed one month, whereas in the simplest exploratory operations the patient may be allowed up on the eighteenth day, or even before. Some surgeons will allow a woman convalescent from ovariotomy to leave the hospital on the eighteenth day. It is well, probably, to err in the direction of encouraging a longer period of rest after these operations. Some complications, notably that of phlegmasia, appear to be encouraged by too early movement.

In a few cases before the patient leaves the surgeon's care an abdominal belt should be ordered. This should be largely composed of elastic, and may be worn from three to six months. After the simplest procedures a flannel binder is all that is necessary; but in cases of pendulous abdomen, and in instances in which the healing of the wound has been imperfect or interrupted, or a very large tumor has been removed, a well-made and very carefully fitted belt is required. The primary object of a belt in these cases is to assist the cicatrix in resisting the weight of the viscera and the passive pressure from within. It must be remembered that the abdominal wall is made up of muscular and aponeurotic tissues. It is required that these tissues should not be weakened. Like tissues elsewhere, they atrophy from disuse and are rendered strong by exercise. The very elaborate, rigid, and heavy belts which are sometimes worn after abdominal section, especially after ovariotomy, may possibly do harm by taking upon themselves too much of the function of the muscles and aponeuroses.

APPENDICECTOMY.

General Principles.—Aseptic operations or operations performed after all acute symptoms of inflammation have subsided require the same general principles of after-treatment as those following ordinary laparotomies, but if the operation has been performed when inflammation or suppuration is present, the wound must be treated after the open method. According to Kocher, acute appendicitis is almost always an exudative periappendicitis, generally the result of perforation, and should be treated accordingly.

In all operations for the removal of the appendix when inflammation is present, Bernays places a strip of 5 percent iodoform gauze around the stump of the appendix and on every piece of gut on which there is a deposit of fibrin or any discoloration or suppuration. Thorough drainage is secured by means of these strips, the important point being to connect each area of injection with the external wound by the shortest possible route. After three or four days the gauze drainage strips are gradually withdrawn, and if upon final removal there is much evidence of suppuration, repacking may be necessary.

If the case is one of purulent perityphlitis or periappendicitis, the treatment is obvious. The abscess must be opened, drained, and kept thoroughly evacuated. When the abscess is well defined and walled off from the peritoneal cavity, the utmost caution is necessary to prevent disturbance or destruction of the adhesions. Frequently in spite of gauze drainage these large abscesses heal slowly, in which case the abscess cavity should be repacked daily with strips of iodoform gauze saturated with sterile cosmolin or balsam of Peru; the former has proved very beneficial in our hands. If the abscess is complicated by fecal fistula, this method of repacking daily will ordinarily suffice to bring about a cure in three or four weeks. If, however, the fecal fistula is large and the patient is declining in health, to shorten the period of convalescence, and render recovery more probable, after gentle but thorough irrigation with normal salt solution of the abscess-cavity a radical operation for the removal of the appendix should be performed exactly as during the acute stage. A fresh incision is made quite apart from the one communicating with the abscess-cavity and as far removed from it as possible, *i. e.*, to the border of the rectus muscle. The adhesions are carefully broken down, the appendix isolated and brought up into the wound together with the cecum if necessary, and the appendix amputated by the usual method. The small intestine and cecum, which may be covered with lymph, must be carefully examined for perforations. The fresh abdominal wound may now be closed and sealed, but the wound leading to the abscess-cavity should be treated after the open method, *i. e.*, packed with strips of iodoform gauze passed well down to the bottom of the cavity. Glass or rubber tubes, as a rule, should not be used. By means of this procedure we have seen large fecal fistulas and abscesses heal with comparative rapidity.

Multiple abscesses following appendicectomy are of frequent occurrence. They usually appear within a week or ten days follow-

ing the operation, and are known to be present by a sudden rise of temperature, with pain in the region of the wound. They may appear subcutaneously as a hard lump or swelling, or may form in the deeper parts of the wound or cavity. Careful exploration with a probe will usually reveal the seat of the pus, which must be given free exit. Thorough exploration under anesthesia may be necessary.

It frequently happens that a counteropening is necessary to secure better drainage, especially when irrigation is desirable. Fig. 66 illustrates this condition, although, especially in postcecal abscesses,

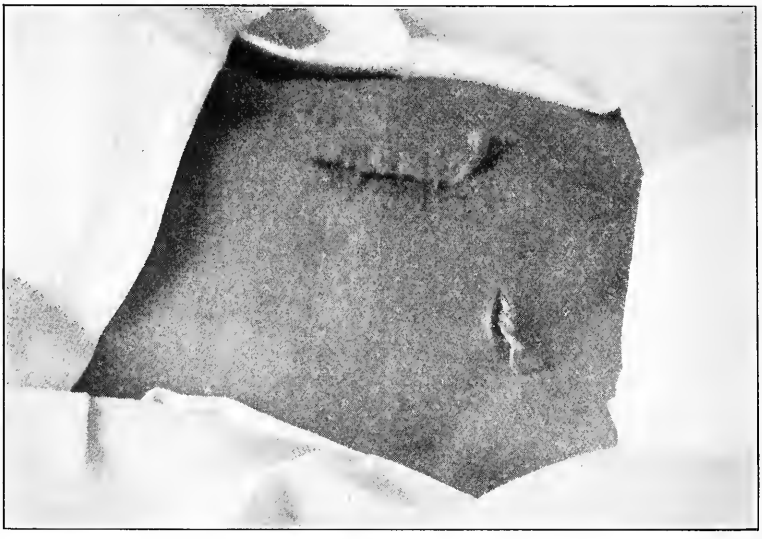

FIG. 66.—COUNTEROPENING TO SECURE BETTER DRAINAGE.

a counteropening through the posterior or lumbar region is more desirable.

Immediately following all severe septic operations a tight abdominal bandage (preferably broad adhesive strips) should be applied, to prevent distention; and lavage of the stomach should be given before the patient is removed from the operating table. So soon as possible after anesthesia the patient should be allowed plenty of water to drink, but no food of any character should be given by the stomach for from three to four days. If all food is withheld, morphin or opium may safely be given, and if peritonitis is present, we know of no remedy more potent in its quieting influence upon the nervous system or in

preserving the strength of the patient. It likewise assists nature by keeping the bowels quiet, thus favoring adhesions and resolution. The early and indiscriminate use of calomel or other purgatives, so commonly prescribed after all laparotomies, is mentioned only to be condemned. As a rule, no purgatives should be administered until the bowels manifest a disposition to move by the rumbling of gas or other symptoms. If meteorism is present, it may call for the introduction of the rectal tube, or high enemas of glycerin may be used as described on page 45.

Ochsner's method of treating the more severe types of appendicitis prior to operative measures has met such general approval that I feel confident if the same common-sense measures were applied to the after-cure of severe septic cases the mortality would be greatly lessened; viz., the prohibition of every kind of food and cathartics by the mouth, and the employment of gastric lavage as indicated by the presence of nausea, vomiting, or meteorism.

After-treatment (Ochsner).—For the first three or four days the patient should be sustained entirely by rectal feeding, nutrient enemas being given every four hours (concentrated predigested food in quantity not more than four ounces); if the patient is normal at the end of this time, a moderate amount of liquid nourishment may be given by the mouth at regular intervals, but if the patient is not normal at the end of this time, the rectal enemas should be continued. In case of pain or restlessness morphin can be safely given, preferably by hypodermatic injections, so long as no food is given by the mouth.

Postoperative Treatment of Appendicectomy as Advocated by Brewer.—In interval cases and in early acute conditions when the abdomen is tightly closed little postoperative interference is necessary if the case progresses favorably. Morphin in small doses may be required during the first twenty-four hours to relieve pain. The bowels should be moved on the third or fourth day. For this, small doses of calomel should be administered, followed by a saline draft, and enemas if necessary.

If much morphin has been used, there may be considerable difficulty in bringing about a movement, on account of the tendency to nausea which prevents the free use of salts. In these cases the frequent use of high enemas will generally be successful if there is no peritonitis. If the pulse and temperature are normal, the dressing need not be changed for six or eight days Obstinate vomiting after oper-

ation can generally be relieved by lavage, followed by absolute rest of the stomach, not even water being allowed. The practice of giving medicines to relieve postoperative vomiting is to be condemned, as they nearly always serve to aggravate the condition. Continued pain and vomiting after operation point to peritoneal irritation; and if the pulse and temperature are elevated and the abdominal tenderness, rigidity, and distention are increased, there is strong reason to suspect a spreading peritonitis. In these cases the wound should be reopened under anesthesia and the peritonitis treated as indicated above. In acute cases in which drainage is employed, the wound should be inspected frequently and the outside dressings changed as often as they become saturated with the wound secretions. If the temperature and pulse remain elevated, and if tenderness and rigidity are present, the drains should be removed and any retained pus evacuated. Digital exploration of the wound with the gloved hand will often enable the surgeon to recognize a collection of pus by the induration, which may not be apparent on superficial abdominal palpation. Such deep-seated collections of pus are often drained best by rubber tubes until the acuteness of the symptoms has subsided. As soon as the sinuses are reasonably clear and granulations appear, further packing is unnecessary and only delays recovery.

In the treatment of a generalized peritonitis the chief indication is to combat sepsis. After the primary focus of infection has been removed and provision made for drainage, elimination should be favored by the action of the bowels, the kidneys, and the skin. Calomel should be administered as soon as the postanesthetic vomiting has ceased, followed by salines and high enemas. If the medicines are rejected by the stomach, it should be washed out and salts introduced through the stomach-tube. Enemas of turpentine, glycerin, and a saturated solution of epsom salt should be given every hour, followed by rectal irrigation with hot salt solution. Intravenous infusions are of the greatest value in stimulating the secretion of urine and inducing active diaphoresis. Cardiac stimulants, as strychnin, digitalis, caffein, and alcohol, should be freely given. Sponge-baths and hot packs will often relieve the intense restlessness and high temperature. The practice of abandoning to their fate patients who develop generalized peritonitis cannot be too strongly condemned. While the great majority of such patients eventually succumb in spite of all treatment, desperate cases are saved occasionally by energetic and persistent treatment.

The author has recently seen such a patient recover after days of continuous vomiting of intestinal matter, enormous distention of the abdomen, a temperature of 108.5° F., and a pulse that could not be counted. In this case every available cutaneous vein in the body had been used for saline infusion. Localized abscesses in various parts of the abdominal cavity are not infrequent during convalescence from a diffuse peritonitis. Their presence is indicated by an acute rise in temperature and pulse, a high leukocytosis, prostration, and the occurrence of sweats. The tenderness may be slight even in large collections of pus, and should be sought for carefully by abdominal palpation and vaginal or rectal examination. The symptoms will promptly subside as soon as the focus is located and adequately drained.

Fecal fistula not infrequently follows appendicitis, especially if the appendix and cecum are greatly infiltrated and surrounded by an abscess. In these cases removal of the appendix may result in injury to the wall of the gut, and a ligature placed around the stump may cut through before it is tightened sufficiently to occlude the lumen of the tube. Under these conditions a fistula may often be prevented by drawing a piece of omentum over the stump and suturing it to the cecal wall. The treatment of fecal fistula consists in cleanliness and frequent dressings. Drainage should be removed as soon as the sinus is sufficiently organized to remain patent, and the opening allowed to heal by granulation. The great majority of these cases heal spontaneously.

Ventral hernia frequently follows operations for acute appendicitis, especially if the wound is allowed to remain open for drainage. The treatment is the same as for other varieties of postoperative ventral hernia.

THE AFTER-TREATMENT OF OVARIOTOMY ACCORDING TO HOWARD A. KELLY.

Comparatively full details of treatment following most abdominal operations have already been described under the head of laparotomy, but certain minor details, so necessary to the comfort and welfare of the patient, have been so clearly and forcibly described by Howard A. Kelly that I feel warranted in placing his ideas in full before the reader.

"Before leaving the operating table the patient is given a high rectal injection of one pint of normal salt solution at a temperature of 108° F. She is then carried to her room and placed in a warm, comfortable

bed. The room should be darkened and the patient left in exclusive charge of the nurse, who should under no circumstances leave her alone for a minute until the effects of the anesthetic have worn off. Restraint must be exercised while under the effects of the anesthesia and passing off only to the extent of preventing the patient from falling out of bed or tossing to and fro.

"Position in Bed.—It is not necessary for the patient to remain persistently upon the back; on the contrary, she may be carefully turned from one side to the other if the change makes her more comfortable.

"Use of Morphin.—If after the effects of the anesthetic have passed away the patient is very restless, or if she has severe pain, which frequently follows oophorectomy, morphin, $\frac{1}{8}$ to $\frac{1}{4}$ grain, may be given hypodermatically, and the dose repeated if sleep during the first night cannot be secured without it. Milder sedatives are useless, but morphin should not be continued longer than twenty-four to thirty-six hours. If the patient is hysterical, codein may act better than morphin. Violent movements should be controlled as far as possible by moral suasion, with efforts at gentle restraint. Under no circumstances should a woman semiconscious and writhing in pain be placed in a canvas strait-jacket and pinned down to the bed by force. They are far more liable to injury in this way than if left uncontrolled.

"Nausea.—The nausea from the anesthetic is variable, being most pronounced after long operations; it usually ceases in from twenty-four to forty-eight hours, although it may last three or four days, or even a week. Little or no nourishment should be given at first while the vomiting is active. If the patient is weak and the nausea persists, nutrient rectal enemas of a small cupful of peptonized milk and the yolks of two eggs, with salt, may be given every six or eight hours Nausea will often be relieved by teaspoonfuls of very hot water, or a drop or two of tincture of capsicum in water, or a quarter of a drop of creasote in a teaspoonful of lime-water. A mustard plaster over the pit of the stomach often helps. (For treatment of severe forms of vomiting by washing out of the stomach see page 78.)

"Toilet.—The personal care of the patient devolving upon the nurse is so important that I add a few directions about cleanliness and toilet. As soon as consciousness returns the hands and face are bathed in cool water and the mouth cleansed with a gauze sponge dipped in ice-water. If there is a tendency to choke up with mucus, the fauces must be wiped

out with a clean napkin used far back in the throat. When the patient is strong enough, a gargle of warm water relieves the thirst and the unpleasant taste of ether in the mouth. The head must be kept low, without a pillow at first, to assist breathing and to lessen the nausea. A hair pillow under the flexed knees gives a more comfortable position.

"Bathing.—The morning after the operation the patient may be given an alcohol bath—one part alcohol and three parts water—at a temperature of 120° F. Beginning with face and arms, carefully placing towels under the parts so as not to wet the bed, and exposing small portions at a time, the whole body may be washed with a soft gauze cloth. The alcohol bath should be given during the first forty-eight hours, after which the regular daily bath of warm water and soap may be resumed.

"Food.—The first food given should be a teaspoonful of milk or hot weak tea at half-hour intervals, increasing the quantity as the stomach becomes tolerant; lime-water may be added to the milk. Strong coffee is also occasionally valuable as a stimulant. Egg-albumen is a tasteless and most nutritious food. It is prepared by beating up the whites of four eggs into a liquid froth, and allowing it to stand in a cool place for an hour or more, when 50 c.c. (about 2 ounces) of liquid albumen may be drained off, leaving the frothy part behind. Another way of preparing albumen is to pour the white of one egg over half a glass of finely crushed ice, stirring gently and adding a little sugar and lemon. Egg-albumen should be made fresh every six to twelve hours, according to the time of year. It is best given a teaspoonful or two at a time, mixed in two or three tablespoonfuls of cold water, with a little sugar, and flavored with five or ten drops of lemon-juice; if preferred, a teaspoonful of sherry wine may be added.

"Additional articles of liquid diet are chicken broth, beef-tea, and the various gruels. Hot oyster-soup, with the oysters taken out, is a valuable and appetizing addition to the diet-list when other liquids have become tiresome. Wine whey and clam-juice are occasionally useful. From 120 to 250 c.c. (4 to 8 ounces) of nourishment will be taken in this way in the second twenty-four hours, increased to 300 to 400 c.c. (10 to 13 ounces) in the third. From the third or fourth to the seventh day, if all is going well, soft diet may be given. This consists of soft-boiled eggs, milk-toast, bread,

soups, custards, and jellies, with milk-punch or egg-nog. After the first week stronger diet may be gradually resumed.

"As the widest divergence of opinion may and does exist as to what a liquid or a soft diet is, I add hereto a diet-list prepared by an experienced nurse.

"DIET-LISTS.

"*Liquid Food:*

"Milk.—Plain, peptonized, sterilized, malted; with albumen, milk-punch, egg-nog, koumiss.

"Wines.—Grape-juice (unfermented), cocoa cordial, wine whey, mulled wine, sherry whip.

"Broths.—Beef-tea, beef broth, broiled beef essence, chicken broth, oyster broth, clam broth, somatose.

"Soups.—Mock bisque, tomato, cream of rice, cream of asparagus, cream of pea, consommé, bouillon.

"*Soft Foods:*

"Eggs.—Poached, shirred, soft-boiled.

"Jellies.—Wine, orange, or coffee jelly.

"Creams.—Apple float; whipped, orange, or Spanish cream; cream of tapioca, cream of rice; baked custard in cups, boiled custard with float, tapioca with baked apples, arrow-root blanc-mange, orange sherbet, lemon sherbet, junket (plain or made with wine), panada.

"SPECIAL DIETS.

"*Oysters and Sweetbreads.*—Creamed oysters, broiled oysters, oysters on the half-shell; creamed sweetbreads, broiled sweetbreads.

"*Eggs.*—Poached, shirred, soft-boiled.

"*Beef.*—Scraped beef sandwiches.

"*Birds.*—Partridges (broiled or roasted), broiled squab, chicken stewed with rice.

"*Porridge.*—Wheat flakes, oatmeal (strained).

"Thirst.—The thirst for the first twelve hours after abdominal section is sometimes overpowering, and the patient in her desire to allay it scarcely knows what she is doing. One of my patients, a desperate ovariotomy case, reached down to her feet and pulled up the hot-water bag, from which she drank at least a quart of warm water. Another, a colored girl, with general suppurative peritonitis, and with a drainage-tube in the abdomen, got out of bed, walked into the hall, and drank a large quantity of water from the spigot of the water-cooler;

neither of them was apparently hurt by her experience. (For the treatment of this important symptom see page 78.)

"Irritability of the Bladder and Decrease in Urinary Excretion. —The temporary partial suppression of urine for the first four or five days after an abdominal section is frequently so marked as to give rise to a fear of the possibility of some grave renal disturbance.

"In a paper by W. W. Russel ('Johns Hopkins Hospital Reports,' 1894), after a careful review of the urinary charts of many cases, the conclusion was reached that the frequency of vesical irritability in post-operative cases was due to the retention of small quantities of highly concentrated urine in the bladder. This theory is unquestionably correct, for a noteworthy increase in the amount of urine excreted after saline enemas has been followed by a marked decrease in the frequency of catheterization, and in vesical irritability, and consequently post-operative cystitis or vesical irritability now rarely occurs.

"A comparison by Clark of a series of 100 cases in which saline enemas were used, with a series of 100 cases without them, shows these interesting points: 'The natural result of almost doubling the watery constituent of the urine is to decrease the specific gravity. The specific gravity of cases in which the enemas are not given ranges between 1025 and 1030, while those with it show a reduction to an average of 1021.'

"There appears to be a further explanation for the greater excretion of urine in the cases which have the saline enemas than that it is merely due to an increase in the amount of water taken into the system. The nausea and vomiting following anesthesia usually disappear by the end of the first twenty-four hours, after which the imbibition of water has not been restricted in either series.

"Notwithstanding the fact that in both series of cases about the same quantity of water is taken by the mouth, the excretion in one remains very low for three days, at no time being above 505 c.c. while the other shows not less than 600 c.c., or over 100 cubic centimeters more urine passed daily by the patients who have had the enemas. From this observation it would appear thatthe persistent renal torpidity is due to the irritant or toxic effects of the greatlyconcentrated urine, and by supplying the body with a liter of salt solution this partial suppression is to a great extent prevented, and the kidney at once resumes its normal function as soon as the patient begins to take water.

"**Catheter.**—The catheter should only be used to draw the urine, if the patient is unable to pass it naturally after six or eight hours, and then the utmost care must be taken to pass a clean catheter, through a clean urethral orifice, under inspection. If the catheter has to be used at all, its use must be discontinued as soon as possible. If vesical irritability is persistent, it will improve upon taking spirits of nitrous ether, 20 to 30 drops, every two hours, or 5 drops of copaiba in capsules three times a day. Balsch ('Münchener medicinische Wochenschrift') states that repeated catheterization may be avoided and the bladder made to assume its normal contractility by injecting into the distended bladder 20 cubic centimeters of a sterilized 2 percent solution of boric acid in glycerin. In the majority of cases this procedure is followed by an evacuation of the bladder without tenesmus in from five to ten minutes, and the patient usually is thereafter able to urinate spontaneously.

"**Bowels.**—I have often noticed that surgeons grow too anxious and work too hard to get the bowels moved for the first time. If the patient is doing well in other ways, it need cause no worry should the bowels be sluggish and not respond until as late as the fifth or sixth day. Often after two or three days of active efforts if the patient is left quite alone they move spontaneously in six or eight hours.

"As a routine line of treatment I give on the evening of the second day something which will move the bowels on the following morning. Calomel will be found to be the most efficacious, and is, as a rule, best borne by the patient. It can be given in one dose of 2 or 3 grains, or $\frac{1}{4}$ to $\frac{1}{6}$ of a grain may be given every hour until the same amount is reached, followed in the morning by 6 to 8 ounces of a solution of magnesium citrate. About two hours later an enema of 100 c.c. of olive oil with 30 c.c. of glycerin should be injected as high as possible into the rectum. If this is not effective, four to six hours may be allowed to elapse before another attempt is made with an injection, consisting of a pint of water at a temperature of 110° F. and soapsuds.

"A satisfactory saline enema much used by C. P. Noble is the following concentrated solution of the sulfate of magnesia:

Magnesium sulfate,	℥ij
Oil of turpentine,	℥ss
Glycerin,	℥j
Water enough to make	℥iv

Mix and inject in bowel.

"It is not advisable to use more than three enemas during the third day; it is better to assist the calomel by castor oil or magnesium sulfate in half-ounce doses, or by a pill of aloin, strychnin, and belladonna. When the bowels are once opened, they should be kept open by a movement at least every other day.

"Tympanites, which often occasions much distress, is usually speedily relieved by the free evacuation of the bowels. Drop doses of tincture of capsicum, or a few drops of tincture of nux vomica in a teaspoonful of hot pepper tea, are valuable adjuvants. A rectal enema of three ounces of milk of asafetida will also often relieve it.

"Temperature.—The temperature must always be carefully watched. On the second or third day it is commonly elevated to 100° F., or even 101° F., but it usually drops with the first free movement of the bowels. This slight rise in temperature appears to be due to the absorption of a fibrin ferment, and it may in exceptional cases be prolonged for several days beyond the usual period. A persistent temperature, however, above 100° is in most cases due to infection either of the wound or in the peritoneum. A sudden rise in temperature, sometimes attended with a chill, toward the end of the first week, is often the first indication of suppuration in the abdominal wall. The wound should be inspected immediately for any hard, red, tender areas on one side or the other, the stitch or stitches at that point removed, and the lips of the incision slightly separated, to favor the discharge of pus. When the pus has escaped, the temperature falls at once.

"Pulse.—The pulse is likely to remain quickened 20 or 30 beats or more for three or four days after any severe operation. If the general condition is good, and the pulse full and compressible, this need cause no anxiety. The normal course is a steadily falling pulse after operation, falling less rapidly if there is much pain. A falling pulse is a good sign; a rising pulse always calls for investigation. In general, a pulse of from 120 to 130 beats needs watching; a pulse of 140 beats needs closer watching; a pulse of 150 beats needs anxious watching; a patient with a pulse of 160 beats does not, as a rule, recover unless it begins to fall within six to twelve hours after the operation. Neither the temperature nor the pulse, however, should be studied alone, but always in association. If the pulse is high—from 120 to 140 beats—combined with a high temperature after the first day, when the bowels have been freely moved, infection has probably taken place. The most satisfactory sign of progress is a free evacuation of the bowels, with a pulse and temperature dropping together.

"Facial Expression.—Facial expression is a sign scarcely less significant than the temperature and pulse, and, taken together with these forms, is a good index of the general condition. A bright natural expression is to be looked for during the normal convalescence; a flushed, dusky, anxious, haggard, or a lack-luster expression is indicative of complications.

"Dressing of the Wound.—Unless some special cause arises, the wound need not be dressed until the tenth day, when fresh gauze and cotton dressings should be put on with the dressing forceps. The bandage may be changed daily, and the back well rubbed with a solution of alcohol and water, half and half. Boric acid and bismuth powder are also good to rub into the back. This rubbing is the best treatment for the severe pain so constantly felt in the back.

"Sutures.—The use of buried catgut suture may relieve the patient, if explained, of considerable anxiety, for often the removal of sutures is looked forward to with great dread. The abdominal dressings need not be disturbed until the tenth day except in case of wound infection. They should be carefully lifted off and replaced by several layers of fresh sterilized gauze. If they have become adherent to the incision, a little sterilized water poured on will rapidly loosen them. The skin about the incision should not be cleansed until about the fourteenth day. Pledgets of cotton wet with dilute alcohol are best for this purpose. The catgut sterilized by the cumol method is usually absorbed by the eighth to the tenth day. Silkworm-gut sutures are removed on the tenth to the fourteenth day. First expose the loop by pulling up the suture a little with forceps, then cut it close to the skin and draw it out toward the side on which it is cut, to avoid pulling the edges of the wound apart. Adhesive straps across the wound after removing the sutures are sometimes necessary. If the bandage is kept well in place, and put on snugly every time the wound-surfaces will naturally remain in close approximation.

"Convalescence.—After ten or twelve days usually the patient may be propped up with pillows or on a bed-rest; and in from seventeen to twenty-one days, according to the rapidity with which strength is regained, she may spend part of the time in a reclining chair or on a sofa. Throughout the convalescence she must avoid straining the abdominal muscles. While still abed she must not raise herself to a sitting posture or change her position without aid. Later she must not stoop or lift heavy weights. During active vomiting the least

strained position is lying on the side with the body slightly flexed, or on the back with the knees drawn up resting on a pillow. At the end of the fourth or fifth week she should be able to walk around and perhaps go downstairs. All bodily movements should be gentle at first. The patient should not sit up long enough at first to grow tired of the newness of it, and later on she should avoid tiring herself on her feet. It is best not to hasten the getting out of bed, as a prolonged absolute rest is an important element in securing complete restoration to health. Heavy work and exhausting exercise of all kinds must be avoided.

"The convalescence is by no means at an end when the patient is able to return to her home. Disappointment will frequently be avoided if she is warned of this beforehand, and kept under observation for a year or more while regaining her physical and nervous balance and passing the period of any unpleasant sequels, such as flushes, sweatings, giddiness, and various other nervous manifestations. Sometimes some of the original discomforts persist for months, only disappearing gradually, so that complete recovery to health does not take place until after a year or a year and a half.

"Fresh air, rest, diet, and tonic treatment, with encouragement, are the most important aids in convalescence. Change of air and scenes are of the greatest value in bringing about complete restoration to health. The golf field is the best form of moderate exercise I know of, and will prove an invaluable adjuvant as soon as the patient is able to take a little active out-of-door exercise."

PYOSALPINX, ABSCESS OF OVARY, ETC.

The after-treatment depends largely upon the extent of the operation, adhesions of the intestines, etc. When it is possible to remove the pus-tubes without rupture, causing the escape of pus into the pelvis or abdominal cavity, careful toilet of the peritoneal cavity is usually all that is required, after which the abdominal wound may be closed and the after-treatment will be the same as after any septic operation; but should an abscess rupture during an operation or should pus escape accidentally, the pelvis should be thoroughly cleansed with sponges, and then the sides of the incision may be pulled up and as much hot salt solution poured in as the pelvis will hold. Kelly recommends that the hot salt solution should be stirred about in the pelvis with the hand or with a sponge on a holder, and the water then sponged out and more poured in. This may be repeated several times until the surgeon is

satisfied that the pus has been well diluted and removed. No drainage will then be necessary. If, however, there is a distinct focus of infection or an injured bowel left behind, a vaginal gauze drainage should be inserted behind the cervix.

Pelvic Abscess.—If the operation discloses a large pelvic abscess with a widespread or a general purulent peritonitis, the course pursued by the operator must depend upon the condition of the patient. The best plan is to make a posterior vaginal counteropening, to irrigate rapidly, clearing out all accessible pus with a sponge, paying special attention to the pelvic and renal fossas. The abscess walls with the ovary or pus-tube should be carefully enucleated. When the patient's condition will permit, the entire abdominal cavity should be washed out, and the separate coils of intestines drawn up and carefully wiped, so that as far as possible every trace of pus is removed. Careful but thorough flushing with normal salt solution, repeated several times, should be done as rapidly as possible. A liberal gauze drainage should then be inserted through the abdominal incision, pushed down into the pelvis, and drawn out through the vaginal incision. In this way several yards of gauze may be employed and gradually removed by the third or fourth day. Some surgeons prefer the insertion of a large glass drainage-tube through the lower portion of the abdominal incision, which, together with a small gauze drainage via the vagina, is ordinarily sufficient, but, in our experience, the more thorough the drainage, the better the prospects of recovery.

The following case, reported by R. C. Turck, of Chicago ("Medical Standard," May, 1903), is typical of many of the severe cases of this character and contains an abundance of interesting and instructive features:

"Miss E., age twenty-eight. Double pyosalpinx, appendicitis, general peritonitis. Entered hospital with symptoms of a general peritonitis. Had had abortion with subsequent septic infection five weeks previously; condition desperate; had been transfused intravenously before taken to the hospital in ambulance. Examination showed intense, diffuse abdominal pain, distention, tympanites, pulse weak and rapid, temperature 101° F., respiration 28; pelvic region extremely tender, apparently a mass of inflamed and adherent viscera. Treated for eight days by constant hot fomentations, liquid diet, morphin, nutrient enemas, lysol douches, etc., reducing pain, temperature, distention, and inflammation.

"*Operation.*—Median abdominal incision. Pelvis and abdomen filled with flocculent, serosanguineous fluid; pelvic viscera, bowel, and omentum formed an agglutinated mass. Broke up adhesions between uterus, ovaries, both enlarged tubes and pelvic wall, bladder, rectum, bowel, and omentum. Left ovary and tube lying in bottom of pelvis. Amputated together with uterine horn. Obliged to cut away large

amount of adherent omentum. Right tube also directed downward with vermiform appendix, highly inflamed, closely adherent to it. Removed appendix and tube and part of ovary. Great amount of raw surface, with much oozing. Toilet with dry sponges. Cut through posterior vaginal wall (Douglas's pouch), and packed deep pelvis with iodoform gauze, carrying end out through the vagina. Inserted large Mikulicz drain deeply through abdominal wound, with glass tube in center of drain. Gave 1000 c.c. normal salt under breasts on operating table. Strychnin hypodermatically. Patient left table in practical collapse.

"*After-treatment.*—Strychnin, $\frac{1}{30}$ grain hypodermatically every two hours; normal salt solution, temperature 108° F. One pint by the rectum every three hours. Drainage during the first twenty-four hours twelve ounces from tube; second day, seven ounces; then an average of three ounces for six days. Normal salt per rectum not retained after fourth day. Temperature never above 100° F. after forty-eight hours. Removed tube on eighth day; also part of gauze below and all of the Mikulicz drain; irrigated and repacked; established through-and-through drainage and irrigation (*i. e.*, in abdominal wound and out vagina). Temperature normal after seventeenth day. Wound gradually healed. Left hospital, walking, on the thirty-fifth day. Wounds completely healed, with patient in excellent condition, gaining weight and strength, no pain, at end of seventh week."

Pelvic abscesses after thorough evacuation should be carefully packed with iodoform gauze or iodoform gauze dipped in balsam of Peru. The patient must be kept absolutely at rest, bowels freely open. Antiseptic hot vaginal douches frequently afford relief. If the condition of the patient remains good, the gauze packing should not be disturbed for three or four days or longer, or until the packing becomes loosened, when all the gauze may be removed with a suitable pair of forceps, and the cavity cleansed with hydrogen peroxid or boric-acid solution, and a fresh iodoform packing applied. This cleansing or dressing is renewed daily, preferably by using speculum and dressing forceps instead of the fingers. Some surgeons prefer to withdraw the gauze drainage slowly, removing three or four inches daily and not washing out the sac until the gauze is all removed—by about the tenth day. If, however, the pelvic peritoneal cavity is opened, the pus must be thoroughly removed, the cavity wiped out and packed, and irrigation, if used at all, must be in small quantities and with the utmost care. In vaginal drainage great care is necessary to avoid a fecal fistula; notwithstanding the greatest precaution, a small opening into the bowel may be made, but will usually heal quickly if the cavity is well packed with gauze so as to prevent fecal matter entering the abscess sac. When this accident happens, the gauze must be removed daily and the pus cavity well irrigated, followed by a firm application of fresh gauze. When the cellular tissue is more or less honeycombed with multiple

abscesses, the progress of a case will necessarily be slow and may require repeated puncture. If the patient does not improve, or if the pain, tenderness, and elevation of pulse and temperature indicate further extension of infection, or if all the pus-cavities have not been evacuated, abdominal incision to secure perfect drainage may become necessary.

APPENDICULAR ABSCESS, PYOSALPINX, OR SEPTIC PERITONITIS.

Method of Drainage after Operation (Nicholas Senn).—"At present there are three methods of drainage in general use: (1) tubular drainage; (2) capillary drainage; (3) a combination of tubular and capillary drainage. All these methods have their advocates and are applicable under certain circumstances. No one method of drainage will answer in all cases.

"Tubular Drainage.—Tubular drainage is specially indicated in cases in which the abdominal cavity contains pus. The tubes employed are made of either glass or soft rubber. Keith's glass drains answer an excellent purpose in draining the lowest portion of the abdominal cavity. They should be slightly curved at the abdominal end, so as to reach the floor of the pelvic cavity without making harmful pressure against the bladder. Frequent aspiration of the contents of the drain is necessary for the purpose of removing the fluid inflammatory product as soon as it is formed. The rubber drain answers the same purpose, but it is properly accused of causing more mechanical irritation than the smooth glass tube. Prolonged tubular drainage has not infrequently caused intestinal fistula by pressure. It is for this reason that I almost invariably surround the rubber or glass tube with a few layers of iodoform gauze securely fastened to the tube. In draining the pelvic portion of the abdominal cavity I frequently use two drains the size of the little finger, one on each side, brought out through the same opening in the lower angle of the wound. In draining the lumbar regions and through the vagina rubber drains should be employed.

"Capillary Drainage.—Capillary drains are frequently employed as substitutes for the tubular drains, and, in addition, must often be relied upon as an important hemostatic resource in arresting parenchymatous oozing. Iodoform or sterilized gauze is usually employed as a capillary drain in draining the abdominal cavity for peritonitis. Bardenheuer first resorted to strips of iodoform gauze in draining the peritoneal cavity. The greatest objections to this method of drainage are

the danger from iodoform poisoning if a considerable quantity of gauze is used, the difficulty of removing the gauze, and the likelihood of a ventral hernia as a legacy.

"The Mikulicz Drain.—The name of Mikulicz is connected with a special method of gauze drainage of his own device, familiarly known as the Mikulicz iodoform gauze or tampon or drain, which has proved of the greatest value in abdominal operations and in the surgical treatment of peritonitis. The typical Mikulicz tampon is made by taking a piece of iodoform gauze the size of a large handkerchief, to the center of which a strong piece of aseptic silk thread is stitched. When used, it is arranged as a pouch and is carried by means of a curved forceps to the bottom of the pelvis and filled with strips of iodoform gauze, the free end of the silk thread issuing from the mouth of the pouch. When it is desired to remove the drain, the gauze strips are removed and the pouch removed by making traction upon the string. Mikulicz speaks of an iodoform gauze drain, and any surgeon who has had considerable experience in abdominal surgery can testify to the fact that when the Mikulicz drain is called for we are frequently dealing with large cavities requiring an enormous amount of gauze. It is in such cases that we must learn to fear iodoform gauze, because the cases are by no means isolated in which a gauze drain composed exclusively of iodoform gauze has been the immediate cause of death from iodoform intoxication. This is particularly liable to occur in cases in which the patient's kidneys are not functionating properly or are diseased. It is in dealing with this class of cases that the elimination of iodoform is accomplished with great difficulty, and hence when accumulation occurs, death is liable to follow from intoxication. Again there are persons who are extremely susceptible to the local and general toxic effects of iodoform. A very small quantity of this substance may prove fatal from intoxication. It is, therefore, advisable, in using the Mikulicz drain, to limit the iodoform gauze to an outer layer or two and pack the pouch with ordinary sterilized gauze. Drainage by using sterilized wicking has been popular in Germany for a number of years, and in many cases has answered an excellent purpose. It has never found its way to any extent into America, where gauze is employed in preference."

A most excellent method of securing capillary drainage has been described by R. T. Morris. To avoid the danger of hard and soft tubes and of unprotected gauze, he recommends wicks, which he em-

ploys in a peculiar way. The simplest wick consists of a little roll of absorbent bichlorid gauze, around which are wrapped a couple of thicknesses of Lister's protective silk. The gauze protrudes a little from each end of the cylinder, and a few small fenestra in the protective silk allow the serum to reach the gauze elsewhere. In certain cases in which injections through a tube are desirable, the soft tube may be surrounded by this wick. When a large gauze packing for the pelvis or abdomen is needed, an apron of the silk can expand over the gauze and protect against intestinal adhesions. This method of drainage possesses great advantages over ordinary tubular and capillary drainage as heretofore described, and recommends itself more especially in the surgical treatment of diffuse septic peritonitis. The prolonged contact of gauze with a serous surface is very prone to give rise to permanent adhesions, as every clinician knows. In employing gauze in draining the peritoneal cavity it is necessary to use long strips, which should be inserted some distance in different directions and brought out at the same place and fastened together with a safety-pin. Van Hook has shown by his experiments that the gauze drains more freely if the external ends of the strips are left long and placed on the side of the pelvis below the level of the wound.

Drainage must be dispensed with as soon as possible, in order to prevent adhesions and to enable the surgeon to close the incision by secondary suturing, an important precaution against the formation of a ventral hernia. The strips should be shortened, and one after the other removed as the indications for drainage disappear.

Combined Tubular and Capillary Drainage.—The simultaneous use of a tubular and capillary drain is an excellent method of securing drainage. It is made by packing loosely a glass drain of proper length and size with strips of gauze or aseptic wicking. This manner of drainage is especially useful when the inflammatory product is serum instead of pus. It does away with the annoyance and risks of removing the transudate at frequent intervals, as is necessary in the employment of simple tubular drainage. If it is the design of the surgeon to resort to frequent irrigation after the operation, tubular drainage is necessary, but to this can be added capillary drainage by inserting strips of gauze into localities that would not be reached by the irrigating fluid.

HERNIA.

Operations for the radical cure of hernia are usually performed under aseptic precautions. The after-dressings consist of iodoform gauze or a pad of plain gauze or lint, or the wound is hermetically sealed with collodion. In very fat subjects a small gauze drain at the lower angle of the wound should be introduced and allowed to remain for two days, to avoid the accumulation of serum. In the great majority of cases, however, no drainage is necessary. An abundance of gauze dressings are applied, over which a bandage is carefully placed, not only around the pelvis, but around the limbs. Some surgeons also use an elastic bandage on the outside of the dressings. This is applied in the form of a figure of 8 around the limbs and pelvis.

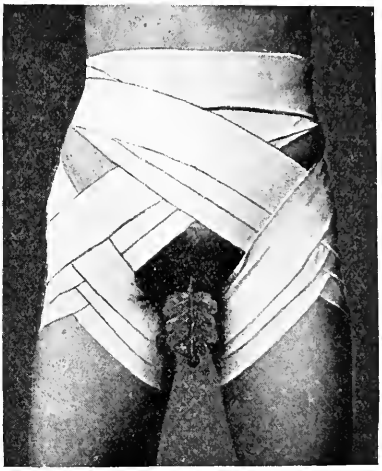

FIG. 67.—DOUBLE SPICA BANDAGE.—(*After Bassini.*)

If the dressings become soiled, or there seems to be excessive oozing, they should be changed promptly. To prevent the dressings becoming soiled, guttapercha tissue or a piece of faconet may be fastened over the dressing in such a manner as to prevent any dribbling of urine. In young children it is best to put on a fixed dressing with collodion.

After-treatment.—The patient should observe the recumbent position, and must avoid all exertion and straining during the period of convalescence. He should not be allowed to lift himself in bed. It often happens that the comfort of the patient may be increased by

allowing the thighs to be kept a little flexed, by introducing a pillow beneath the knees. In male patients retention of urine is occasionally complained of.

The dieting of the patient should be upon the lines observed in the after-treatment of cases of abdominal section. Opium should not be administered unless distinctly indicated. The bowels should be opened on the fourth day by an enema, unless previously relieved. Flatulent distention of the belly may be relieved by the use of the rectal tube, or, if severe and persistent, by means of a saline aperient. In some

FIG. 68.

rare cases a severe diarrhea sets in within a day or so of the operation, and is not only very difficult to cope with, but may soon lead to death from exhaustion.

The drainage-tube, if employed, should be removed within forty-eight hours in ordinary cases that are doing well. The sutures may be taken out on the eighth day or later. The wound should be dressed whenever the bandage becomes loose, and the parts around must be frequently washed with hydrogen dioxid or alcohol, and kept scrupulously clean and dry with powdered zinc stearate.

The patient should not be allowed to get up until three weeks have elapsed after the operation, and then only if the wound is sound. The question of a supporting bandage or a truss will then have to be considered. If the surgeon has been able to perform a radical cure at the time of the herniotomy, no truss need be worn, otherwise a light truss will be required. In the case of a large femoral hernia it is difficult to prevent recurrence, and hence a truss is usually advisable.

Complications.—The most important complication occurring during convalescence is suppuration, which takes place occasionally, and varies in extent according to the method of the operator, and is generally attributed to faulty disinfection of the deep stitches or suture material or undue suture pressure. This may be so, but we are by no means sure that the infection is not more frequently due to incomplete disinfection of the skin or some faulty manipulation on the part of the surgeon or his assistants. However that may be, suppuration after radical cure very seriously interferes with the result of the operation. Separation of the tissues takes place in practically all cases in which suppuration occurs and the wound does not heal until all septic suture material is absorbed or thrown off. As this may take a long time, the inguinal canal becomes infiltrated with inflammatory cells and converted into cicatricial tissue which yields gradually before the weight of the abdominal contents. Hence the sooner the septic stitches are removed the better, and we would advise that whenever the accident has occurred, the wound should be opened up, either by turning aside the original flap or, in some cases better, by a second smaller incision over Poupart's ligament, so as to expose the lower end of the deep stitches, which are found and removed; in this way much time is saved. (Cheyne.)

It sometimes happens that, long after the wound has healed and the patient has been about, a small vesicle forms in the scar and leaves a sinus leading down to a stitch; this has happened even many months after the operation, and the sinus will not heal until the stitch concerned has escaped or has been removed. The cause of this is not quite clear. It may be some peculiar quality of silk or it may be due to some slow-growing nonpyogenic organism introduced along with the silk at the operation, or, again, it is conceivable that the tissues around the stitch become infected from the blood at a later period, when the patient's resisting power is not good. Fortunately, in our experience at any rate, this is an excessively rare occurrence, and need not be taken into consideration. Various applications have been suggested to prevent

stitch abscess. Our hernia cases seem to do best without overpreparation. Just before the operation a simple but thorough scrubbing of the skin after the hair is removed is all that is requisite. The sterilization of the deeper surfaces of the skin is very difficult, if not impossible, hence the application of mercurial ointment, soap poultices, and all such methods only tends to increase the danger of infection, or at least favors dermatitis. When we have reason to believe that sepsis is almost inevitable after careful preparation of the skin, a Murphy dam should be applied to cover the entire inguinal region and genitalia, the dam to remain in position until the sutures are inserted and tied, after which it is lifted at one end and divided at or near the points of suture.

According to Kelly, unnecessary handling of the wound, rough retraction of the skin edges, or prolonged pressure with metal retractors, carelessness in checking bleeding in the wound, strangulation by tying the ligatures too tight or too close together, all conduce to the formation of stitch abscess.

Of the many plans adopted for the prevention of stitch abscess, we will mention only that of Blondel. He makes as few stitches as possible through the skin, and before drawing them tight he wipes the sutures and edges of the wound with 90 percent alcohol, and sponges the tissues with gauze dipped in it. Each suture is treated in the same manner before tying, and after the wound is closed it is dusted with xeroform, iodoform, or equal parts of dermatol and aristol. Alcohol dries the surfaces better than any other substance. Its effect on grease is also a factor in the result, and it has a coagulating effect on the serum and thus favors cicatrization.

POSTOPERATIVE HERNIA.

General Considerations.—Postoperative hernia is much more common than is usually supposed. It may follow faulty technic or closure of the abdominal incision. In the majority of instances it occurs in cases in which drainage has been used. This is because the drain separates the fascial sheaths of the recti muscles and other surfaces which otherwise would immediately unite. The small opening thus made in the wound increases, and hernia results. It is one of the most distressing sequels, causing the patient constant discomfort when erect, limiting to a great degree her activity, and even endangering life from incarceration of the bowel in the sac. It was far more frequent in the days when the abdomen was habitually drained after the opera-

tion. "Hernia is more frequent in women, who become stouter after operation, and in whom the intraabdominal pressure is increased." (Kelly.)

The Cause of Postoperative Hernia.—In an effort to ascertain the cause for the development of hernia following abdominal operations, Wolfe has tried the various kinds of sutures and suture materials as well as different forms of abdominal binders after operation without being able to discover that they bear any direct relation to this subject. A careful study of the histories of patients seemed to demonstrate that hernia occurred most frequently in the cases in which pronounced abdominal distention developed within the first few days after operation, regardless of the method by which the wound was closed. The distention probably acted as a direct factor in the production of hernia by causing the fascial sutures to yield or cut through. Abdominal distention and abdominal hernia developing shortly after operation seemingly stand in the relation of cause and effect.

Since making these observations two years ago the author has closed completely only those laparotomy wounds in which an absolutely uncomplicated course would be expected. In all other cases, in which more or less secretion could be expected, in which the peritoneum was traumatized, or in which only a mild recent inflammation was found, he introduced a small iodoform gauze drain and thereby prevented postoperative meteorism. Since adopting the above plan the author is convinced that the sutures retain a firmer hold and hernia develops less frequently.

After operations on hernia developing in the linea alba, the intraabdominal pressure and the lateral traction of the transverse and oblique abdominal muscles weaken the newly formed scar tissues and favor a return of the hernia.

Of the 14 cases of postoperative hernia that have come under my personal observation, 12 followed superficial infection of the abdominal wound after laparotomy, and 2 followed prolonged drainage in appendicular abscess. Of the 12 laparotomy cases, the hernia occurred in the linea alba or line of incision, following the use of the subcuticular silver wire suture, and 7 were found to be devoid of the peritoneal covering, *i. e.*, the edges of the peritoneum had been widely separated, the protruding bowel being held in position solely by the muscles and fascia. In the other cases (5) the peritoneal sac was unusually large.

Operations for postoperative hernia differ only from ordinary hernia, (1) in the removal of all scar tissue; (2) the redundant sac of peritoneum, if present, should be removed, and the edges overlapped, as recommended by Andrews; (3) in the absence of the peritoneal covering, the peritoneum must be found and bluntly freed, dissected, or loosened well back from the adherent tissues. The edges must be freshened and lapped or closely approximated. This is often a very difficult matter, and if there is great tension or difficulty of approximation, retentive button sutures of silkworm-gut passing through the entire thickness of the abdominal walls should be used as a matter of additional reinforcement. A blunt-pointed round needle should be used, in the insertion of the sutures, and the edges of the intermediate, subcutaneous, and cutaneous tissues carefully freshened before closing the incision.

In order to obtain a firmer scar at the site of operation, Menge devised a new method, which he has employed in two cases with very satisfactory results. The hernia is exposed by a transverse incision and the hernial sac is extirpated. The anterior layer of the sheaths of the recti muscles is then divided by a transverse incision extending from each side of the hernial ring outward for a distance of three centimeters beyond the inner edges of the separated recti muscles. The recti are then dissected free from the anterior and posterior layers of their sheaths, care being taken to avoid unnecessary injury to the bloodvessels. The anterior and posterior layers of the sheaths are then separated from one another above and below the hernial ring, and from the recti muscles inward to the median line by means of the forefinger. In the median line the two layers are too firmly united to permit of their separation by blunt dissection, but this can be accomplished by splitting them with a knife for a distance of three centimeters above and below the hernia orifice. The posterior layer of the rectal sheath is now sutured transversely, the mobilized edges of the recti are brought together and sutured in a longitudinal direction, the anterior sheath of the recti is closed transversely, and the fat and skin are united in separate layers by continuous sutures. By this method of forming flaps, longitudinal pulls on the scar are expended on the intact fibers of the recti, lateral pulls are resisted perfectly by the two layers of the sheaths of the recti, and a tendency to the recurrence of the hernia is thereby greatly diminished.

UMBILICAL HERNIA.

Postoperative Treatment (Mayo's Method).—In very large protrusions in which part of the hernial contents are irreducible the patient must be kept in bed on a reduced diet for several weeks, and directed to manipulate the hernia with the intention of replacing the hernia as much as possible. The irreducible portion must not be forced into the abdominal cavity after losing the right of habitation. If very fleshy, the hernia large, with a view to the reduction of weight, the patients are placed upon a restricted diet for several weeks; purgatives are frequently administered and the entire intestinal tract emptied as far as possible. After the operation the ordinary dressings are applied—sometimes superficial drainage for forty-eight hours. The patients are kept in bed from three to four weeks upon a light diet, and after getting about are not allowed to apply a truss, although most of them prefer to wear an ordinary abdominal elastic supporter for a year.

CHAPTER XII.

OPERATIONS UPON THE UTERUS, VAGINA, BLADDER, AND KIDNEYS.

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ABDOMINAL HYSTERECTOMY.

After-treatment.—The finished operation of abdominal hysterectomy should leave the peritoneum of the pelvis completely closed and the cervix representing the stump of the operation well buried beneath that serous membrane. The operation when completed should show the bottom of the pelvis smooth, free from bleeding points, and with the peritoneum intact at all places. The toilet of the peritoneum and the closure of the wound are the last steps in the operation. After removal of all blood from the bottom of the pelvis the large gauze packs should be carefully removed, the intestines should be replaced in the bottom of the pelvis, and omentum spread carefully over the surface of the wound. The operation being performed under strict asepsis, these patients, as a rule, recover rapidly from the operation. They should be stimulated with normal salt infusions and by strychnin, and reaction established as early as possible by the application of dry heat, etc. Retention of urine is quite common after this operation. Every effort, however, should be made to have the patient pass urine voluntarily, the catheter being used only under strict asepsis as a last resort. After the first twenty-four hours attention should be given to proper nourishment of the patient, the prevention of meteorism, etc. Further after-treatment is practically the same as for laparotomies in general, to which the reader is referred.

VAGINAL HYSTERECTOMY.

After-treatment.—Martin, who uses the **forceps and clamp method,** states that patients after a vaginal hysterectomy are treated in the same way as after an abdominal incision. The one exception to be made is in the management of the bladder. On account of the dressings, the patient should be catheterized until after the forceps are removed. The dressings are not disturbed until it becomes necessary to remove the forceps, and then only the external dressings.

The forceps are removed in sixty-two hours in the following manner: The external dressings and wrappings are removed from the handles of the instruments and the silk securing the handles is cut. Without disturbing the dressings any more than is necessary the lock of the forceps is then opened, and the blades separated so that the pressure is taken off of the tissue in the grasp of the blades, but the forceps are not removed immediately from their location. The forceps of the opposite side are treated in the same way, the blades being separated, and then the operator waits for at least fifteen minutes, in order to make certain that hemostasis is secure. If for any reason a rush of blood occurs during the period of waiting, it is only necessary to lock the forceps, and, as they have not been disturbed, one is very sure that no harm can come as a result of this relocking. After the end of fifteen or twenty minutes the forceps may be carefully removed, the dressings cut off level with the vulva, and an abundant supply of soft, fresh, perineal dressings applied. Twenty-four hours after the removal of the forceps the packing is removed from the entire handkerchief. Twenty-four hours after this, vaginal douches of sterile water or boric-acid solution may be employed, great care being observed to keep the reservoir low in order to avoid pressure, and also to secure a good and complete return flow immediately so as to run no risk of distending the vagina and causing the entrance of fluid into the abdominal cavity. From this time on douches may be employed, and later antiseptic douches of mercuric chlorid, or other materials, may be used as indicated. Patients are allowed to urinate after the forceps are removed, care being maintained to renew the dressings after each urination.

Suture Method.—Kelly states that when the effects of the anesthesia have worn off, it is not necessary to keep the patient on her back. She will be greatly relieved from time to time by being gently turned over on one side or the other; after a few days she may turn on her face and urinate in this posture. At first the catheter should be used three or four times daily. The bowels should be moved on the third day by a laxative pill, followed by a warm enema of oil and soapsuds, or of glycerin and oil, 180 c.c. (6 ounces). During the evacuation she must avoid straining. If the fecal matter does not easily pass out, the nurse must assist with her fingers. After this, a movement must be secured every other day. The diet during the convalescence should consist for the first two or three days of liquids, followed by soft foods,

nourishing soups, toast, soft-boiled eggs, oyster soup, various starchy foods, etc.

Pain following the operation is often entirely absent and is rarely unbearable. Hypodermatics of morphin should be used sparingly to relieve severe pain during the first twenty-four hours.

If the pack continues dry, and there is no discharge from the vagina, it may be left there five days longer. To remove the pack the patient is brought with the buttocks to the edge of the bed with the thighs flexed. The operator slips a narrow Sims speculum into the vagina, retracting the posterior wall, and with dressing forceps draws the strips of gauze out from between the ligatures. As soon as the strips are removed the vaginal vault must be cleansed with pledgets of absorbent cotton, and a fresh pack inserted.

No vaginal douches of any kind should be used until three weeks have passed, when a 3 percent warm carbolized douche or boric-acid douche may be given once or twice daily, using a short nozle and taking great care not to push it too far in. When silk ligatures are used, the discharge is sure to become odorous sooner or later, and the vagina must be cleansed more frequently. The ligatures loosen and come away with a little traction in bunches, in from four to six weeks. It is a good plan not to wait for them to become detached, but in the course of three weeks to expose and remove them with forceps and scissors. These sutures can be removed most easily with the patient in the knee-breast or the Sims posture.

Convalescence.—After eighteen days the patient may sit in a reclining chair a little while each day, and after this gradually increase her movements, until after four weeks, when she is usually able to be up all day. At this time an examination will show that the vaginal vault is closed, and the wound area has contracted down to a transverse granulating linear scar, with the granulations more abundant at each end. After six or eight months this whole line has contracted still more, until it is a thin white cicatrix closing the vault.

After a hysterectomy the patient should avoid hard work, heavy lifting, and prolonged exertion for several months. Recovery of health is usually rapid; within a few months a pale, emaciated woman often regains all her lost vigor. But the surgeon still has a duty to perform in continuing to watch these cases, examining them at first at intervals of two or three months, and later every six months, in order to detect at once any recurrence of the disease. It will occasionally be

necessary to cut out a small area of recrudescence in the vaginal vault, which will be detected at an early stage by this careful inspection.

ALEXANDER'S OPERATION FOR RETROVERSION.

After-treatment.—Immediately following the operation the patient is placed in bed, preferably in the prone position, or if the posterior vaginal vault has been well packed with gauze and the fundus of the uterus held well upward, the patient may be turned very gently upon either side. General restlessness or constant turning or changing of the position very frequently results in such tension upon the tissues as to cause stitch abscess or necrosis of the tissues, with subsequent suppuration, hence the patient should be cautioned regarding unnecessary movements, and morphin used for pain or to enforce quietude. The operation is usually performed under strict asepsis, and healing by first intention is the usual result. The operation being extraperitoneal is seldom accompanied by serious complications.

The general treatment as to diet, etc., is the same as following a simple herniotomy. The stitches should be removed on the ninth day, and if there is no suppuration or other evidence of sepsis, should be dressed in the usual manner. If at any time septic symptoms are manifest, sufficient stitches should be removed to relieve tension, after which the treatment is the same as for that of ordinary septic wounds heretofore described.

TRACHELORRHAPHY.

After-treatment.—The following points laid down by Emmet are essential to proper healing, and necessary to secure satisfactory results: The cicatricial plug in each angle must be completely removed. The strip of mucous membrane left in the median line, which is to serve as the mucous lining of the restored cervical canal, must be of sufficient width to prevent stenosis. Sufficient tissue should be removed on each side of both lips to allow them to come into apposition without tension. All the sclerosed tissue must be removed.

For about ten days after the operation the patient is kept in bed, and not allowed even to sit up. This may seem to be unnecessary caution, but when we consider the dragging down of the uterus which occurs during the operation, this period of rest seems only prudent, even though the healing process were proceeding satisfactorily. Dur-

ing this period carbolized douches are employed to preserve cleanliness, the bowels are kept regular, and she is allowed to pass her urine voluntarily if possible. After any operation the catheter should be avoided as much as possible, for its use is very prone to cause irritation of the bladder, which may easily prove more annoying than the operation itself. I do not allow the catheter to be passed by touch alone, but insist that the urethra and adjoining parts be thoroughly cleansed and then the catheter introduced by sight.

Removal of Sutures.—The usual custom is to remove the sutures at the end of about ten days, but my habit for some time past has been to examine the patient with the Sims speculum at the end of this time, and if the stitches do not appear to be causing irritation or are not in danger of cutting through, they are let alone, and the patient is allowed first to sit up, and then to walk around. If she menstruates within a short time, it is best to leave the stitches in until this is past. After this they are removed, the vagina cleansed, and a tampon of tannin and iodoform introduced.

As regards the manner of removing the sutures, it is only necessary to say that the cervix is exposed with the Sims speculum, and with an ordinary uterine dressing forceps the stitch farthest away from the external os is grasped, and the suture cut, care being taken not to cut off the knot, for then it is almost impossible to find the suture. If the nearest suture is removed first, one is likely to tear open the cervix in removing the other less accessible ones. If the upper ones are removed first, and there should be a little oozing, the field of operation is obscured by the blood. After removing the stitches the sound is introduced to be sure that there is no obstruction in the cervical canal. The fissures left by the sutures will usually be obliterated in about a week.

NEPHROTOMY AND OPERATIONS IN GENERAL UPON THE KIDNEY.

In operations upon the kidney or urinary tract it is usually advisable to place the patient upon a course of salol 45 grains or urotropin 15 grains daily for several days prior to the operation.

Nephrotomy can be performed from the front or behind. The anterior incision recommended by von Bergmann is generally known as the lateral incision, although the chief part lies on the anterior aspect of the abdomen. For the majority of cases of simple nephrotomy

the posterior oblique incision, as recommended by Czerny and others, may be regarded as the normal incision in the lumbar region, as it corresponds with the course of the vessels and nerves and gives the best access to the deeper parts.

In **nephrorrhaphy** the thin fibrous *capsula propria* of the kidney is incised and stripped from the organ so that a good grip of it may be included by the four to six sutures which are used to unite the capsule to the lumbar fascia. The exposed kidney substance lies at the bottom of the wound, which is ordinarily left open, healing taking place by granulation in order that firm scar tissue may extend from the skin to the kidney substance. In all operations upon the kidney where the substance of the kidney has been interfered with it is almost necessary to treat the wound by the open method, not only on account of the escape of urine or the fear of a urinary fistula being formed, but also for the reason that the surrounding tissues are readily infected.

If the pelvis of the kidney has been opened or if there is any indication of infection, a tampon of iodoform or xeroform gauze should be inserted down to the pelvis of the kidney, or a drainage-tube inserted, after thoroughly washing out the pelvis and wound with sterile salt solution. If an ordinary drainage-tube is used, it should be surrounded with iodoform or xeroform gauze and fixed in position with a strip of gauze and collodion. The outer dressings require to be changed frequently.

In operations for nephrorrhaphy or fixation of the kidney it is essential that the cicatrization which follows should involve a considerable area of the kidney substance itself, for it is only in this way that certain and permanent fixation is possible. The endeavor to obtain union by first intention does not give as satisfactory results as the open method of treating the wound, complete healing by granulation requiring four to six weeks.

In **nephrectomy** the method of removing the kidney depends upon the disease. If possible, the kidney should be freed *in toto* after all the large vessels entering the capsule have been carefully ligated and the structures at the hilus carefully isolated. The ureter, which lies lowest, is ligated last, the renal artery and vein being fixed firmly and tied. The wound may now be closed, two short glass tubes being introduced for twenty-four to thirty-six hours.

When suppuration is present or infective processes exist, the ureter, unless it can be completely extirpated, is stitched to the wound. Ex-

cision of the ureter is, however, always preferable, and the wound under these circumstances should be carefully packed with iodoform gauze and treated after the open method.

After operations upon the kidneys the skin and bowels should be kept very active and the patient kept warm and comfortable. It is essential that the amount of urine passed should be carefully measured, that any diminution in quantity may be detected at once. Should the skin around the wound become inflamed or sore from the secretion of urine or discharge, sterilized benzoated zinc oxid ointment should be used freely. Following nephrectomy, pain is sometimes very severe, requiring the use of morphin hypodermatically, but morphin when used in these cases should always be combined with digitalin in order to overcome the tendency toward diminution of urinary secretion. A complication of persistent vomiting, so common after operations upon the kidneys, may be overcome by some of the methods heretofore mentioned. A temperature of 103° to 105° F. is not uncommon after nephrectomy or operations upon the kidneys. This ordinarily should occasion no alarm, being reflex in character and supposed to be due to interference with or irritation of the sympathetic nerves. A subnormal temperature followed by a pronounced rigor is indicative of sepsis and calls for prompt examination of the wound.

Abscess of Kidney.—After the evacuation of the pus and the exploration of the cyst, the kidney should be well flushed out with warm sterilized water; a drainage-tube is then introduced up to the kidney. This is packed round with gauze, and the parietal wound is closed around the tube.

In cases in which the kidney is found to be very mobile the organ must be steadied while the abscess cavity is being dealt with; and before the tube is inserted it may be desirable to secure the too movable gland in place by means of two or more deep sutures introduced into the renal tissue. The after-treatment of these cases differs in no essential from that indicated in nephrolithotomy. The tube should be shortened gradually, the dressings must be frequently changed, and the wound cavity be frequently and freely irrigated.

OPERATIONS UPON THE BLADDER.

Preparatory Treatment.—Before undertaking any operation upon the bladder (according to Ochsner) it is desirable that the urine should be as nearly aseptic as possible. Measures should be taken

to make the urine as nearly normal as the condition of the patient will permit. The condition for which the operation is performed usually predisposes to an abnormal state of the urine, and frequently not only the bladder but also the kidneys are diseased. If the urine contains septic material, this condition can be changed by dilution, the patient being given large quantities of distilled water, or, if this is not agreeable, one of the various mineral waters may be given in large quantities. This in itself will reduce the septic nature of the urine to a great extent. If the urethra is permeable to the passage of a catheter, irrigation of the bladder with a mild nonirritating antiseptic solution, such as a solution of boric acid, a 1:1000 solution of permanganate of potash, a 1:2000 solution of silver nitrate, a saturated solution of aluminium acetate, or a solution of any one of a number of the recently produced silver salts, may be used to advantage. Care should be taken not to irritate the bladder with any of these solutions. If it is found that one irritates more than the other, it should be avoided. The bladder should be filled moderately full and then the fluid should be permitted to escape again, or the bladder may be irrigated with a constant stream through a double catheter, one tube serving the purpose of introducing the fluid, the other the purpose of emptying the bladder. A repeated examination of the urine will determine whether this treatment reduces the amount of septic material regularly found.

There are a number of antiseptics which can be given internally for the purpose of disinfecting the urine. Of these, 5-grain doses of boric acid given with half a pint of distilled water or mineral water every three hours; the same dose of salol, or of urotropin, or one-grain doses of methylene-blue given in the same manner, are probably the most useful. There is, however, this fact to remember, that urine usually is most septic if the bladder is not at any time completely evacuated, and consequently in these cases but a slight amount of benefit can be expected unless this residual urine is removed once or twice, or oftener, each day and the bladder carefully irrigated.

Suprapubic Cystotomy.—After-treatment.—Ochsner states that the most important point in the after-treatment of these cases consists in giving the patient large quantities of pure water to drink. If the patient is at all shocked by the operation, it is wise to give saline transfusion at once or to give an enema of half a pint of normal salt solution every hour. The bladder is irrigated with a saturated solution of boric acid from two to six times a day, according to the character of the urine.

Considerations of Technic.—If the operation has been performed for the purpose of securing permanent drainage, the incision should be made as near the os pubis as possible, and should be only just large enough for the purpose of permitting careful digital exploration. Several purse-string sutures should then be applied in order to prevent leakage, and a retention catheter introduced. The wound should be tamponed around this retention catheter and the stitches in the bladder wall should be passed through the edge of the wound and tied just sufficiently tight to hold the anterior wall in close apposition with the abdominal wall. A few silkworm-gut sutures are then applied, so as to grasp the wound on each side, and to take a small bite in the anterior wall of the bladder above the point of incision, and two small bites, one on each side of the incision in this portion of the bladder. These sutures are left untied until the first dressing, which occurs a few days after the operation, when the gauze tampon and the three first stitches may be removed and the silkworm sutures may be tied, leaving only a space through which the drainage-tube passes. If the bladder has been in a septic condition, it is often best to pass two ordinary rubber drainage-tubes, one-half a centimeter in diameter, perforated with several small openings in the end, and these two rubber tubes should be sufficiently long for the ends to project into an antiseptic solution in a bottle tied to the side of the bed. It is then possible to irrigate the bladder by permitting the fluid to flow in through one of these tubes and out of the other; and in case one or the other becomes occluded with mucus or blood, the free one will suffice to drain the bladder. It is a good plan to insert a glass tube into the end of the rubber tube, so that its weight will keep it from becoming dislodged from the bottle. If the presence of the rubber tubes gives rise to pain, their position should be changed occasionally. (See Fig. 69.)

If the operation is performed for the removal of a stone from a healthy bladder containing nearly normal acid urine, the wound in the bladder may be closed by a double row of catgut sutures, which are not permitted to penetrate the mucous membrane, however. The space between the bladder and the abdominal wall should always be drained thoroughly in these cases for fear of extravasation of urine. A soft-rubber retention catheter is placed into the bladder through the urethra in such instances and carefully fastened in place, so as to keep the bladder thoroughly drained. If there is any doubt about the asep-

tic condition of the bladder, it does not seem wise to close the bladder wall completely, in which case the wound is treated after the open method, with fresh gauze packing daily, and healed from the bottom by granulation.

Senn advises two stages in the operation in cases of septic cystitis: After the anterior wall of the bladder has been exposed and all hemorrhage arrested, the wound is packed with iodoform gauze and the dressing held in place by strips of adhesive plaster; this dressing is allowed to remain for five days; at the end of this time the wound, if it has

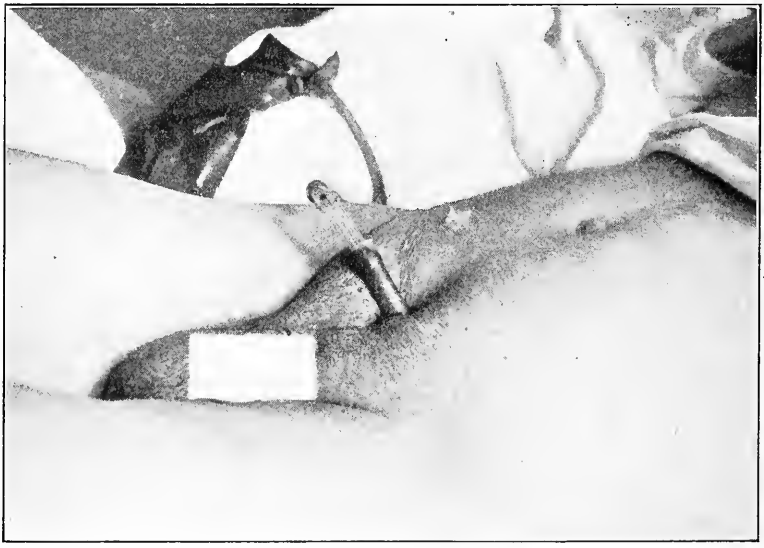

FIG. 69.—SUPRAPUBIC DRAINAGE. TUBE IN SITU.

remained aseptic, is covered with a layer of healthy granulations, which have closed the connective-tissue channels and have shut out from the wound the remainder of the prevesical space. As a second stage, with the danger of infiltration lessened by these favorable circumstances, the bladder is incisied and drained in the usual manner; under this operation cocain is adequate without general anesthesia. In relation to this modification of suprapubic cystotomy Senn makes the following statements:

"(1) Necrosis and phlegmonous inflammations of the margins of the wound and the tissues in the prevesical space (cavum Retzii) not

infrequently occur as complications of suprapubic cystotomy if the operation is performed for affections complicated by septic cystitis. (2) Suprapubic cystotomy in two stages greatly diminishes, if it does not entirely overcome, this source of danger. (3) In the first operation the bladder is freely exposed in the usual manner, when the prevesical fat is dissected away over a vertical oval space at a point corresponding to the location of the proposed visceral incision, after which the wound is packed with iodoform gauze and the external dressing is applied in such a manner that it cannot be displaced. (4) The incision in the bladder and the intravesical operation are postponed until the external wound has become covered with a layer of active granulations, which usually requires from four to six days. (5) The second operation can be performed with the aid of cocain without general anesthesia. (6) This modification of suprapubic cystotomy diminishes the immediate risks of the operation and affords protection against a number of serious postoperative complications."

AFTER-TREATMENT.—(Method of Sir Frederick Treves.) If the wound in the bladder has been closed by sutures, the after-treatment of the case is conducted upon the lines observed after any ordinary abdominal section. The employment of the catheter, if the patient cannot pass urine, is imperative. A soft catheter should be introduced as often as required. The superficial sutures may be removed at the end of a week; and if all goes well, the patient may be sitting up in ten days.

If the wound in the bladder has been left open, the after-treatment becomes very tedious, and demands infinite care. The bed must be protected by mackintosh sheets, placed beneath the usual draw-sheets. A large cradle is spread across the pelvis. The care of the wound will demand the constant and undivided attention of a nurse.

The skin of the perineum, buttocks, and lower part of the abdomen should be kept as dry as possible, and should be smeared with vaselin to prevent the irritating effects of the contact of urine. Over the wound should be placed a large sponge, and above the sponge should be a large pad of absorbent wool, applied transversely, like a scarf, from one side of the groin to the other. This pad rests upon the pubes. It keeps the sponge in place, and serves to absorb any urine which may escape the sponge. It may be conveniently replaced by pads of cyanid gauze, frequently changed. Not less than 20 sponges should be in use. The arrangement of the bed-clothes over the cradle allows the part to be always in view, the patient's trunk and limbs being well covered up with blankets.

The sponges and wool-pad must be changed as often as needed—possibly two, three, or four times in the hour. The pad is, of course, thrown away, but the sponge may be used over and over again. Each sponge is well rinsed in water, is then immersed for some hours in carbolic lotion, is once more rinsed, and is then dried ready for use. Before each sponge and scarf of wool are applied, the skin should be rapidly dried. No bandage is required. The patient must lie upon the back, and should assume, as soon as he is able, the sitting position. If he wishes to lie upon one or the other side, the sponge and the wool pad must be adjusted to meet the altered position.

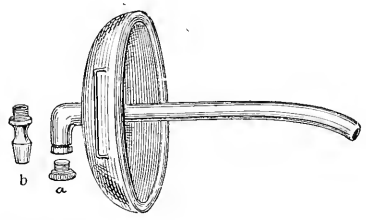

FIG. 70.—STEVENSON'S SUPRAPUBIC DRAINAGE-TUBE.—(*Da Costa.*)

If this plan is carried out by intelligent and painstaking nurses, the patient's bed may be kept absolutely dry, and the skin perfectly sound and free from excoriation. The sponges can be changed during sleep without waking the patient, the wound being always in view through a "window" in the cradle. The sooner the patient can sit up in bed, the better, as the wound is much more readily dealt with when that attitude is assumed. Any "dressing" secured with a bandage round the body is useless. By the time the dressing has been applied and the bandage secured, the whole arrangement is

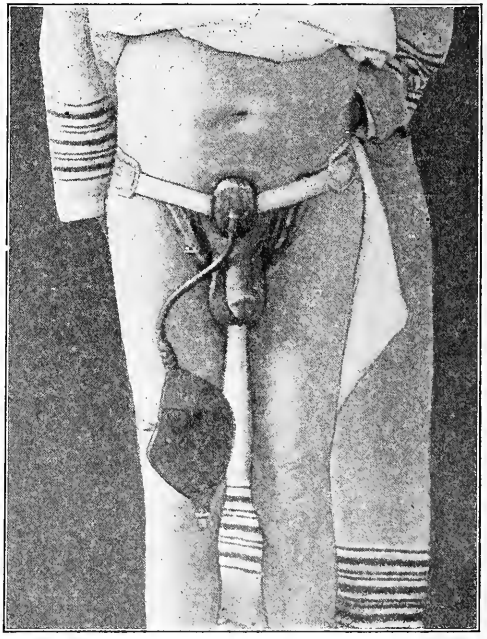

FIG. 71.—STEVENSON'S SUPRAPUBIC DRAINAGE-TUBE IN PLACE AND ATTACHED TO A RECEPTACLE FOR URINE.—(*Da Costa.*)

probably soaked with urine. The bladder may, when necessary, be washed out with a boric-acid solution as often as occasion arises.

Temporary Drainage.—A convenient form if there is not too much pus in the urine is provided by anchoring two large soft-rubber catheters together by suture through the eyelets, passing the double tube thus formed through the suprapubic wound and into the bladder. Each of these is connected to a rubber tube by means of a glass coupler. The tubes lead into a basin beneath the patient's bed. The advantage of this apparatus is that if one tube becomes blocked, the other will drain the bladder, and also irrigating fluid may be passed through one tube and the other will drain the fluid away.

The bladder wound usually closes in two, three, or four weeks, and the external wound one or two weeks later. It is probable that the patient will be able to be moved into a chair by the end of the second or commencement of the third week.

According to A. B. Craig, of Philadelphia, when permanent suprapubic drainage is necessary, one of the best forms of apparatus for this purpose is seen in Figs. 70 and 71.

LITHOLAPAXY.

After-treatment, according to Dennis, consists in rest in bed, milk diet, and moderate doses of quinin, salol, or boric acid. The average stay in the hospital after litholapaxy in adults is about ten days. Even calculi of large size are at the present day treated by litholapaxy. Buckston-Browne has on several occasions crushed uric-acid calculi weighing over three ounces, and also reports crushing a cystin calculus weighing two and a quarter ounces; such a weight of cystin indicates a calculus of large size, as cystin is a light substance.

Keegan, after reporting 50 cases, which bring his total up to 175, with 5 deaths, lays down the following rules to guide the inexperienced in performing the operation of litholapaxy in boys: The surgeon should be provided with an ample supply of perfectly reliable lithotrites, all of the completely fenestrated pattern, and with cannulas with serviceable stylets. He should never withdraw a cannula from the bladder nor introduce one unless it is fitted with a stylet. Four ounces (124 grams) of water should be the maximum quantity allowed to be in the bladder at any given moment. The aspirator should be used gently and methodically, and water should not be injected into the bladder while the patient strains. Extreme gentleness and care are essential

in practising all manipulations of instruments in the bladder and urethra. The operator should not be in a hurry to finish the operation, and if possible he should not leave a grain of débris behind in the bladder. If all these conditions be fulfilled, a large measure of success will be obtained.

Guyon in his last 49 cases of lithotrity has used a retained catheter, keeping it in place for twenty-four hours. In 40 of these cases there was absolute apyrexia, and in the other 9 merely a slight and transitory elevation of temperature. Of the patients, 27 had old phosphatic calculi, were obliged to empty the bladder by catheterism, and had been infected for a long time. Guyon remarks that, even admitting that fever and cystitis are rare after lithotrity at the present day, this experience demonstrates that the retained catheter may be employed without causing vesical inflammation, as formerly thought to be an invariable consequence. My own experience would not lead me to think it necessary in the majority of cases, but his testimony would lead me henceforth to employ a retained catheter after litholapaxy in old persons with infected and atonic bladders and with enlarged prostate.

Sir Henry Thompson's Method of After-treatment.—The patient must lie in bed. An india-rubber hot-water bottle or warm fomentations may be applied to the hypogastrium. Some opium may be required. There may be some urethral fever, or retention of urine from atony of the bladder. Not infrequently subacute cystitis appears on the fourth or fifth day. The administration of urotropin or cystamin in 5-grain doses and the injection into the bladder of a few ounces of solution of silver nitrate (half to one grain to the ounce) are useful for this complication. The patient should be kept on a light or milk diet, and remain in bed until any cystitis has subsided. If the stone is small and there have been renal symptoms, the opportunity should be taken to exclude the existence of other calculi in either kidney by skiagraphy. A warm hip-bath daily adds greatly to the patient's comfort. The urine contains no trace of blood, as a rule, after the second to the fourth day; and in the majority of cases the patient may be allowed to get up on the seventh day. An occasional and troublesome complication, occurring especially in adults, is orchitis or epididymitis.

According to Freyer,* the average number of days spent in hospital

* "Brit. Med. Jour.," May 9, 1891.

or under treatment is, in adult males, six; in boys, five and a half; and in females, four.

Results.—Sir Henry Thompson's cases of lithotrity since 1878 number 378, including 325 treated each at one sitting. The mortality is a little over 3.5 percent.*

Cadge expresses his belief that the relapses after simple lithotrity reach to nearly 20 percent, if the cases of phosphatic deposits and concretions common after this operation are included among the examples of recurrence of the stone. Litholapaxy is attended with no such proportion of unsatisfactory results; and, indeed, if the evacuator be carefully and thoroughly employed, the relapses after litholapaxy will probably include no cases of recurrence due to the actual retention and subsequent increase of a fragment.

PERINEAL LITHOTOMY.

Dennis states that when the calculus has been extracted and the bladder has been explored for other chance calcareous deposits adhering to the walls, or for other concretions, the bladder should be thoroughly irrigated with moderately hot water to wash out any clots of blood which may have entered it, and also to stop any slight oozing from the edges of the wound. If the hemorrhage be considerable and the vessels cannot be ligated, the air-tampon or *catheter en chemise* should be inserted. The packing which is inserted within the cuff of the latter instrument may be removed at the end of two or three days. W. A. Mackay reports favorably on the use of glass tubes for drainage after perineal or suprapubic lithotomy associated with cystitis. To the end of the glass tube a soft-rubber tube is attached, and conveys the urine to a vessel beneath the bed, in which the end of the rubber tube is kept constantly submerged in an antiseptic fluid. The glass tubes should be slightly smaller in caliber than those ordinarily used in abdominal sections. No other dressing is used except light packing around the tube and a T-bandage in perineal cases. Drainage should be maintained until the urine becomes clear.

When prolonged drainage is not deemed necessary and the hemorrhage is not sufficient to demand packing the wound, then only a light pad of iodoform gauze should be applied, but not pressed in so tightly as to prevent the free escape of urine through the wound, which will

* "Med.-Chir. Trans.," 1890.

continue for a day or so, and then, owing to the inflammatory swelling, gradually cease.

After-treatment.—The patient is placed on a narrow bed with a firm horsehair mattress, protected by a waterproof sheet. Beneath the buttocks are kept squares of old sheeting, which can be changed as often as they are wet with urine. In addition to the sheets, large sponges may be employed to absorb the escaping urine. They can be readily changed without disturbing the patient, they are easily cleansed, and if plenty are employed, and each one is allowed to lie for some time in a carbolic solution before it is used again, the same sponges ean be employed over and over again. They need to be well dried by heat before being applied, and may be dusted with iodoform.

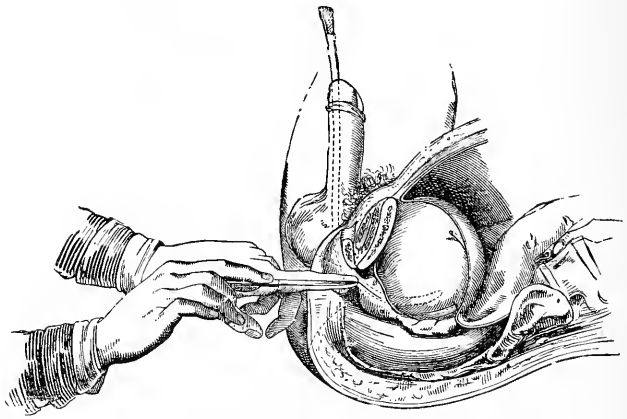

Fig. 72.—Lateral Lithotomy with a Curved Staff.—(*Bryant.*)

A rope and handle-bar suspended above the bed will enable the patient to raise his pelvis readily when the squares of sheeting are changed. The knees should be supported by separate pillows, with an interval between them. Nothing must obstruct the free exposure of the tube. Clots in the tube may be removed with a moistened feather. If the escape of urine ceases and there is pain about the bladder, the tube may be pushed a little further in, or a soft-rubber catheter may be introduced through it into the bladder. In most cases the tube may be removed in thirty-six or forty-eight hours. In some few instances—especially when there have been difficulties of micturition previous to the operation—the tube may have to be retained for three or four days or even longer.

The parts exposed to the contact of urine should be dried as frequently as is possible. The scrotum should be kept away from the perineum by a simple suspender or "crutch pad." When the urine is alkaline and irritating, the skin of the buttocks and perineum should be smeared well with vaselin after each change of sheets or sponges. In cases of actually putrid urine the bladder should be washed out two or three times a day with a warm solution of boric acid. The urine begins to flow by the urethra, as a rule, between the eighth and twelfth day, and the perineal wound is generally healed and the patient "cured" within four to six weeks. The same care in the diet is observed as is customary after all major operations. If the bowels are not opened by the third day, a laxative should be given.

When secondary bleeding occurs, the patient should be placed once more in the lithotomy position, and the wound thoroughly cleansed and examined. The tube should be removed, and the clots washed out of the bladder.

When the incision has been dried, it is possible that the bleeding point may be detected, especially if the perineum be in a good light and the wound margins be well retracted. In such a case pressure forceps will meet the complication. Failing the easy securing of the divided vessel, cold injections may be tried; but if they fail, as is most probable, the tube should be reinserted, and the wound plugged with gauze. Injections of powerful styptics, and especially of perchlorid of iron, are to be absolutely condemned.

Complications.—The following complications may occur during the after-treatment: Retention of urine from blocking or displacement of the tube. Suppression of urine in cases in which the kidneys are diseased. Incrustation of the wound with phosphates may occur when the urine is ammoniacal and there is much cystitis. This is especially met in aged and feeble patients. The condition is met by frequent irrigation of the bladder with boric-acid lotion or mildly acidulated solutions, and by constant attention to the wound. Epididymitis is not infrequently met after lateral lithotomy. Cellulitis from urinary infiltration is, of all the possible complications, one of the most serious. It is fortunately uncommon.

PERINEORRHAPHY.

After-treatment (Martin).—After the operation the patient must lie in bed until the wound is sound and the sutures are all removed.

This will represent a period of from fourteen to twenty-one days. The patient should be encouraged to lie upon the side. A cradle should be

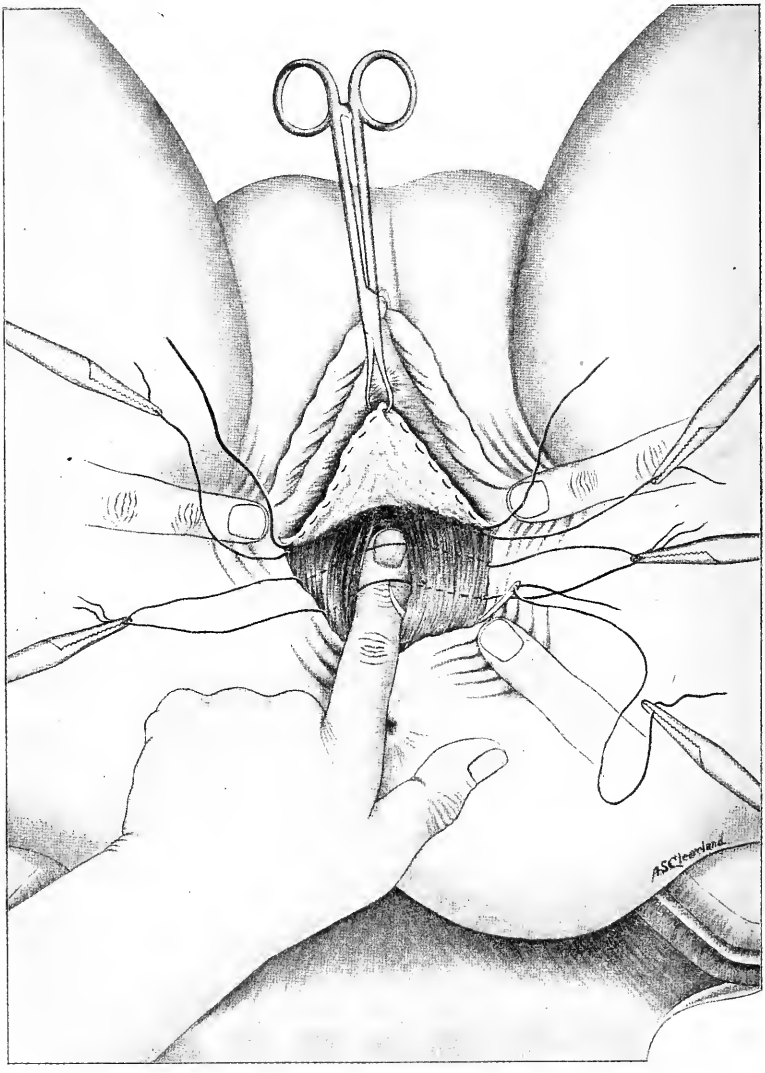

FIG. 73.—SUTURE OF PERINEUM AFTER MARTIN'S METHOD.—(*By permission.*)

placed over the pelvis, the space under the bed-clothes should be ventilated, and every opportunity be taken to change the heated and close atmosphere with which the wound must of necessity be surrounded.

It is never necessary to tie the legs together, as was the barbarous and senseless custom at one period. No T-bandage is required. The

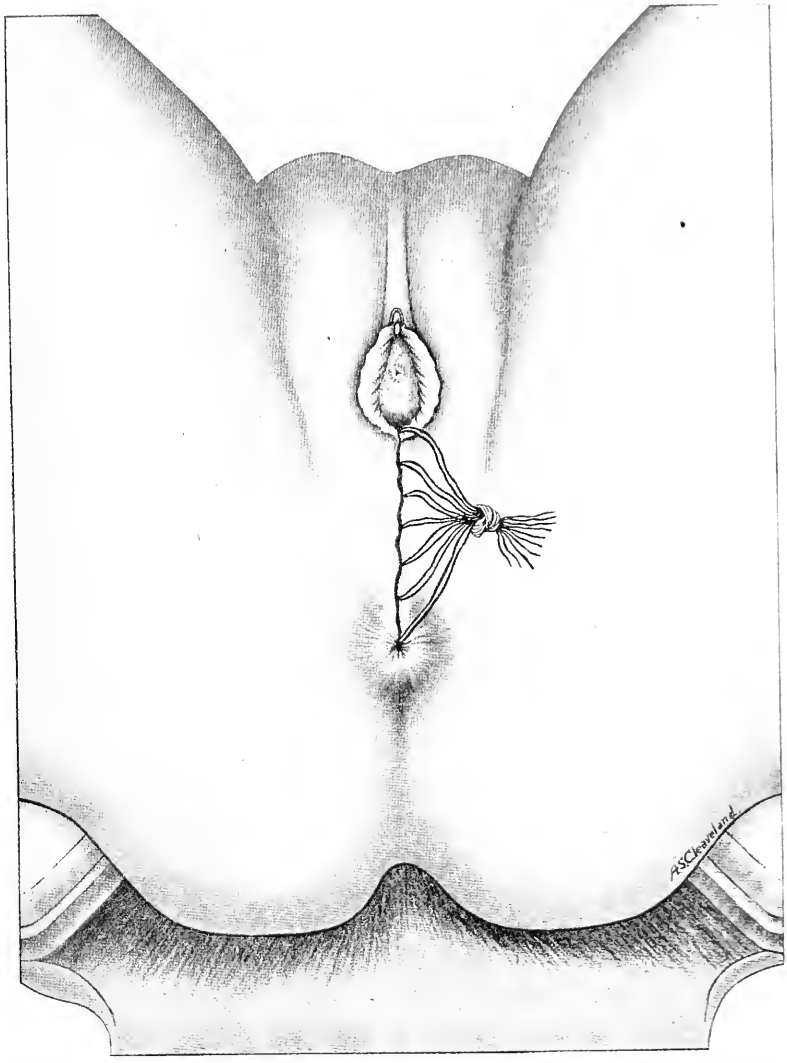

FIG. 74.—COMPLETE CLOSURE OF PERINEUM, SHOWING BURIED SUTURE KNOTS.—(*Martin, by permission.*)

wound is best dressed with iodoform. This may be liberally dusted over the part, the wound being left otherwise uncovered; or a "sani-

tary towel" well treated with iodoform may be worn, and the wound be supported by the soft pad of the "towel." The part should be kept throughout as dry as possible. Some patients suffer excruciatingly after these operations—much more so, as a rule, than after ordinary laparotomies. Hypodermatics of morphin are frequently indispensable, but should be avoided when possible. Great difficulty with the bowels may result from the too free use of the drug.

Catheterizing the Patient.—Almost any patient, if properly encouraged, will be able to urinate without the use of the catheter, and clean urine will be less harmful to the perineum than the indiscriminate use of the catheter will be to the urethra. The patients, therefore, are requested to urinate, first removing the dressings from the perineum before the attempt is made, and the nurse is instructed to irrigate the perineum immediately after the urination with a saturated solution of boric acid, normal salt solution, or even sterilized water.

Attention to the Bowels.—All patients should be prepared, prior to the operation, by a thorough evacuation of the intestinal canal. They are kept upon liquid food for at least two days before the operation. The intestinal tract is rendered as aseptic as it is possible to make it. Twenty-four hours after the operation laxatives should be administered, assisted, if necessary, by mild stimulating enemas. No attempt to establish constipation should be made; the bowels should move naturally from the first.

Care of the Perineum.—Besides dressing the perineum with pads of fluffy, sterilized gauze after each urination of the patient or movement of her bowels, the perineum is, as indicated before, irrigated several times a day and the dressings replaced.

A note must be made at the time of the operation of the number of sutures inserted, as it is not uncommon to find, when weeks have elapsed, that a suture has been overlooked.

As the sutures are of silkworm-gut, it is necessary that they be removed, and their removal is accomplished on the twelfth day after the operation. As the sutures are tied just within the skin-margin, the operator will find that the knots, after complete union has occurred, are buried beneath the skin. The removal of the sutures, therefore, is a point requiring considerable delicacy of treatment. After the sutures are separated and identified, one end of the stitch is grasped and gently drawn upon until the knot is brought through the opening made by the single suture. Then, by cutting beneath the knot on one

side, the suture is easily withdrawn. It is well to remember this injunction, as it is a very difficult and painful procedure to attempt to cut beneath the knot unless it has been drawn through the skin.

In the case of the complete operation, the perineal sutures are removed first, and the rectal sutures at a later period. The removal is in the reverse order to the introduction. A small rectal speculum will probably be required when the rectal stitches are taken out.

The patient should be allowed to sit up on the fifteenth to the seventeenth day, and gradually to get about at the end of the third or the beginning of the fourth week. All patients should be instructed to use considerable care to avoid heavy physical work for several months.

CHAPTER XIII.

OPERATIONS UPON THE RECTUM, PROSTATE GLAND, URETHRA, AND SCROTUM.

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OPERATIONS UPON THE RECTUM, PROSTATE GLAND, URETHRA, AND SCROTUM.

HEMORRHOIDS.

The postoperative treatment depends largely upon the method employed for the removal of the hemorrhoids. The ligature has been for many years the most popular method among surgeons for the treatment of hemorrhoids. It is perhaps to Allingham, Matthew, and Ricketts that this operation owes its great popularity. It is applicable to almost every variety. Many American surgeons, however, prefer the clamp and cautery method. Whitehead's method of total excision, or Earle's modification of the Whitehead operation, the Pratt or so-called American operation, are likewise popular.

Preparation of the Patient.—In order to obtain the best results from any of the forms of operation, the patient should be as carefully prepared as for laparotomy. Thirty-six hours before the operation the bowels should be thoroughly emptied and the patient placed upon a very light diet. The evening before the operation, after the parts have been carefully shaved to the anus and perineum, a mercuric chlorid dressing should be applied and retained by a T-bandage. No purgative or injection should be given the night before the operation; on the contrary, the patient should have a quiet, restful night. No enema should be given the morning of the operation, but after the patient is anesthetized the sphincters should be dilated and the rectum thoroughly irrigated with a 1:3000 mercuric chlorid solution and the external parts made surgically clean with soap and water, followed by the mercuric chlorid solution, and, lastly, alcohol. The bladder should also be emptied before beginning any operation, and this should be done before cleansing the operative field.

Postoperative Treatment of the Ligature Method.—Allingham attributes all the unfortunate results which follow this method to the faulty after-treatment. For the prevention of complications he lays down the following rules: He confines the bowels for four or five days, using opium or morphin freely for this purpose, and for the relief of

pain. On the day following the operation the outside dressings are removed. The parts are dusted with iodoform or some such powder, and after this only small pledgets of dry gauze will be necessary. To many patients a dressing moistened with a mild antiseptic solution, if applied hot, is more grateful. The bowels are moved, according to the necessity of the case, after four or five days. Whatever laxative is selected is given in sufficient dose to compel movement of the bowels, even against the patient's resistance, for at this time the sphincter will have regained its tonicity, and the fear of pain will cause the patient to hold the movement back as long as possible. The best laxative is one-half to one ounce of castor oil, administered in two to four drams of port wine.

When the inclination for a movement begins to be felt, an injection of warm sweet-oil into the rectum will facilitate it, and prevent any friction by the fecal mass upon the stumps and ligatures. In the majority of cases the patient may sit upon the commode for this purpose; it makes the movement easier and causes less straining than when the bed-pan is used. As Allingham says, there are patients so anemic and debilitated that the recumbent posture is desirable, and in these the use of the bed-pan for several days will be necessary. After the bowels have once moved, boric-acid solution should be injected into the rectum, and expelled again in order to wash away any fecal material which may have adhered to the raw surfaces. If there is any difficulty in obtaining a movement of the bowels, the finger should be introduced at once to ascertain if impaction has taken place; and if so, it should be broken up. Allingham advises the introduction of the finger into the bowel every day after the first week in order to avoid any contraction; he confines the patient to bed for one week or more, and does not allow him to walk about until the wounds are healed.

After the bowels have moved for the first time, gentle traction should be made upon the ligatures daily in order to withdraw them when they have cut their way through. This should be very carefully done lest too much dragging should tear off a pedicle and thus bring about secondary hemorrhage.

The time required for complete healing by the ligature method is from twenty-five to forty days. The period of confinement to bed is from five days to three weeks.

After-treatment of the Clamp and Cautery Method.—There are two methods of treating the wounds following removal of the hemor-

rhoids. One is the application of a soft, fluffy piece of gauze infiltrated with iodoform, xeroform, or orthoform to the external raw surfaces. This is covered with a good pad of gauze or absorbent cotton, and held in position by a T-bandage. If the sphincter is thoroughly relaxed, and if there is no tendency to contract, this dressing is quite as satisfactory as any other. In many cases, however, it seems impossible to paralyze the sphincter muscles by stretching, and in such cases it is customary to use a Pennington tube, which consists of a piece of medium-sized stiff rubber tubing about six inches long, attached to which is a sheath of very thin rubber. The tube or part to be inserted is wrapped with iodoform gauze until its size is sufficient to keep the sphincter well dilated, and the rubber sheathing is then folded over the gauze. The part of the tube surrounded by the gauze is then introduced about four inches into the rectum with the uncovered end of the tube protruding from the anus, orthoform or iodoform having been previously dusted freely upon the raw surfaces within and about the anus. The tube serves to allow the escape of any gas which may accumulate within the rectum, to control hemorrhage, and to maintain the dilatation of the sphincter. The rubber sheath prevents granulations from forming in the meshes of the gauze. The gauze is then packed around the lower end of the tube and a snug T-bandage applied, through which the end of the tube protrudes in order to prevent pressure upon the latter. A large safety-pin is fastened through the end of the tube in order to prevent its escape upward into the rectum, and thus the dressing is completed.

As a rule, it is best not to use any plug or tampon in the rectum, but when there is much pain and contraction of the sphincter, the method of Pennington will prove of great service. The tube should be allowed to remain until the third or fourth day, or be allowed to come away with the first movement of the bowels. When the tube is used, the patients generally have to be catheterized, and it may be necessary to administer one or two hypodermatics of morphin during the first twenty-four hours. It is customary to give a hypodermatic injection of morphin, $\frac{1}{2}$ to $\frac{1}{4}$ grain, before the patient leaves the operating table. On the second night following the operation 20 to 30 minims of fluid extract of cascara or castor oil may be administered, and, as before directed, when the bowels feel like moving, warm sweet-oil should be injected into the rectum. After the bowels have moved and the rectum has been irrigated, a small piece of gauze infiltrated with some

antiseptic powder should be applied to the anus two or three times a day, to keep it dry. If there is a tendency to contraction or spasm of the sphincter, a full-sized rectal bougie should be introduced daily.

The time for healing after this operation varies from two to four weeks, the average being twenty-one days. Patients are allowed to get out of bed after the bowels have moved on the third or fourth day. They can generally walk about without any distress, but sitting may be uncomfortable. They are allowed to use a commode for the first movement of the bowels. There is often some hemorrhage after stools for the first week or ten days, but it is never alarming, and only comes from granulating surfaces.

Crushing Method.—Some recent operators have used the angiotribe in carrying out the crushing operation. Other instruments have been invented and used for this purpose, viz., Smith's and Allingham's being the most frequently used, but none are superior to the old Kelsey clamp. After having crushed the hemorrhoids, collodion should be applied. The parts will often heal as if they had been sutured. The cauterization of the stump before applying the collodion is a safeguard against hemorrhage.

Following the excision method, pain is usually very great for eight to ten hours. Morphin is the best remedy to control it after all operations, but if the patient is extremely nervous, large doses of sodium bromid will act more satisfactorily. The smarting pain which follows the movement of the bowels in either operation may be relieved by the application of pure iodoform or a 10 percent ichthyol ointment, or the insufflation of orthoform just before the stool.

Strangury and dysuria very frequently occur after the ligature method. Hot applications over the pubis and allowing the patients to stand on their feet will frequently enable them to pass their urine voluntarily; but, these methods failing, catheterization should be performed under strict asepsis.

Secondary Hemorrhage.—The danger of secondary hemorrhage is very much exaggerated. If severe, the rectum may be thoroughly packed with gauze. The introduction of astringents is unnecessary and injurious.

Abscess and Fistula.—These conditions have been known to follow operations by ligature, by the clamp and cautery, and by the excision methods, and are usually the result of faulty drainage. The only treatment in these cases is to dilate the sphincter thoroughly and

drain the abscess as soon as the swelling is discovered. After excision, the abscess may form in the stitch holes. As soon as they appear the surgeon should remove the stitches and thus give exit to the pus. A sudden rigor with rise of temperature after forty-eight hours or more following the operation should excite suspicion and cause immediate examination of the parts.

Stricture.—Stricture rarely follows except after the Whitehead operation, and is usually due to cicatricial contraction. The rectum should be dilated daily with a moderate-sized bougie until the wound is entirely healed.

Ulceration and Fissure.—Protracted ulceration or chronic fissure sometimes follows the Whitehead and ligature operations. The constitutional condition of the patient accounts for the majority of cases. Dilatation of the sphincter under anesthesia with applications of iodoform or ichthyol ointment usually affords prompt relief.

EXTIRPATION OF THE RECTUM.

Preparation of the Patient.—In order to obtain the best result it is necessary to increase the patient's strength as much as possible by forced feeding for a time. The intestinal tract must be emptied of all hard and putrefying fecal masses, to establish so far as possible intestinal asepsis. Seven to ten days are usually required to properly prepare a patient for this operation.

An absolute milk diet is not so satisfactory as a mixed diet composed of meat broth, milk, and small quantities of bread and refined cereals. The patient should be fed at frequent intervals, and given as much as he can digest. Daily saline laxatives should be given in sufficient quantity to produce two or three thin movements. The rectum should be irrigated by mild antiseptic solutions of mercuric chlorid, potassium permanganate, or, as recommended by Quénu, hydrogen dioxid.

Numerous methods have been devised by various surgeons for extirpation of the rectum by the perineal route, but on account of the vast areas of tissue laid open, and the unsatisfactory access to the rectum which they give, they have practically been rejected, though Cripps' and Allingham's methods remain popular, owing to the fact that the mortality from extirpation of the rectum by the perineal route is much lower than by any other method. After removal of the rectum by

either of these methods the posterior and anterior portions of the perineal wound are packed with iodoform gauze and left open to insure drainage. The parts are covered with aseptic pads held in position by well-fitting diaper or broad T-bandages. A large drainage-tube is passed well up into the rectum, its lower end extending outside of all the dressings in order to convey the discharge and gases beyond the operative wound.

Kraske's Operation, or the Sacral Method.—After all oozing is checked by hot compresses, the cavity of the sacrum is packed with a large mass of iodoform or sterilized gauze, the end of which protrudes from the lower angle of the wound. The skin-flap is sutured in its original position with silkworm-gut which passes deeply through the skin. The lateral portion of the wound is closed by similar sutures down to the level of the sacrococcygeal articulation. Below this it is left open for a drainage. A large rubber drainage-tube is carried up through the gut beyond the line of intestinal sutures, and the whole is dressed with iodoform or sterilized gauze, held in position by adhesive straps and a firm T-bandage. The patient is placed in bed, lying upon his back or right side, and the head of the bed is elevated slightly in order to afford better drainage. There is always considerable oozing for the first twenty-four hours following the operation, during which time the outside dressings should be replaced several times by fresh ones. The inner packing or drainage should be left in position for seventy-two hours; after this it is removed, and either drainage-tubes or small gauze strips are introduced into the hollow of the sacrum. The patient is kept upon concentrated liquid diet, and if a preliminary artificial anus has not been employed, his bowels should be confined by opium for the first ten days, after which they are moved by enemas of oil and glycerin.

The Vaginal Method.—Extirpation of cancer of the rectum through the vagina or the removal of carcinoma of the lower loop of the sigmoid via the vagina has been popularized by Murphy, of Chicago. After extirpation, the peritoneum is closed with a continuous catgut suture and the vaginal wound is brought together with silkworm-gut sutures. A large drainage-tube is introduced through the anus above the point of anastomosis and sutured in position. The vagina and external parts are dressed with iodoform gauze. In order to facilitate better drainage, Tuttle recommends a semicircular incision between the anus and the coccyx, extending into the retrorectal space, and

through this incision the sacral concavity is packed with iodoform gauze. The use of silkworm-gut sutures in the intestinal wall necessitates their removal under anesthesia on the twelfth or fourteenth day. The use of a ten-day chromicized catgut serves every purpose and does not require removal.

Combined Methods.—The combination of abdominal with other methods for extirpation of the rectum has been suggested from time to time. Abdomino-anal, abdomino-peritoneal, abdomino-sacral, all have their advocates. Mayo's modification of Maunsell's method is a fine conception, and may prove later the ideal method. The after-treatment in all forms being practically the same, recovery is dependent upon proper drainage.

When end-to-end approximation of the bowel has been employed, a large, firm, rubber drainage-tube should be passed through the anus and extend above the line of anastomosis in order to prevent any tension upon these parts from the accumulation of gases or fecal material.

Postoperative Complications.—Sepsis.—The chief complication which follows all forms of operation of extirpation is sepsis. According to Tuttle, 75 percent of the deaths occurring from extirpation for cancer of the rectum are caused by infection. Whether this is due to faulty technic, to the escape of fecal material during the operation, to ruptures of the sutures after the operation, or to the presence of bacilli in the perirectal tissues at the time of the operation, it is impossible to say. No technic has been devised which will positively secure asepsis in all operations of this type. A certain amount of sepsis, therefore, is unavoidable. Every effort should be made to protect the peritoneum.

Gangrene.—Gangrene is the next most serious postoperative complication. This may be the result of deficient blood-supply, too great tension of stitches, etc., or may result from infection. If from either of the first two causes, the condition will develop within the first twenty-four to thirty-six hours. If from the latter, the intestine may appear perfectly healthy for two or three days, and then entirely slough away. There is no possible way to avoid these complications except through the most rigid asepsis. The systematic employment of a preliminary colostomy simplifies the after-treatment and lessens mortality.

Incontinence of feces is a very frequent complication following the sacral method of extirpation. To avoid this, Gersuny has pro-

posed twisting the gut two or three times around before it is sutured in position. Willems carries the superior segment of the intestine through the fibers of the gluteus maximus muscles, thus constituting a sphincter ani.

FISTULA IN ANO.

Technic.—There are several methods of operating for fistula, and the after-treatment varies accordingly. The operation by radical excision as first recommended by Stephen Smith, of Bellevue Hospital, is now generally adopted. A medium-sized rectal tube wrapped with a small quantity of gauze and covered with rubber protective is introduced about three inches into the rectum and allowed to remain for several days, in order to facilitate the escape of gas which may come from the intestine above.

The after-treatment of this method is as follows: The patient is confined absolutely to bed, the bowels are controlled by opiates for six or seven days, the patient being limited to albuminoid diet, but milk is excluded. At the end of six or seven days the bowels are moved by the injection of five ounces of warm water and one ounce of glycerin, in which is dissolved two ounces of inspissated oxgall. This proceeding may have to be repeated several times before an efficient evacuation is obtained, but Smith does not consider it advisable to attempt the use of any laxative or purgative until the lower bowels have been relieved of any accumulation of hardened fecal masses, such as are likely to follow the administration of opium and prolonged constipation. After these masses have been dissolved by the above method one may then administer some mild laxative and induce daily movements.

Rest in bed is incumbent upon these patients for at least two weeks in order to secure firm and perfect healing of the part. The stitches are usually removed about the seventh day, but not before movement has been secured.

When primary union fails, resort must be had to healing by granulation, the wound being treated similarly to other septic wounds. The large majority of failures which follow operations for fistula are due to one of two facts, either a specific fistula is mistaken for a simple one, or the opening into the rectum is not found and thus a part of the track remains. The method of after-treatment advocated by Grant, Tuttle, and others varies somewhat from the above, hence is given in full.

Postoperative Treatment for Fistula in Ano (Method of Grant).—It may almost be said that the after-treatment of the case is of more importance than the operation. When all bleeding has been checked, the parts should be well dried, and a folded piece of lint, or, better still, a strip of iodoform gauze, should then be lightly packed into the incision. A large pad of wool is applied over the part to maintain pressure, and to overcome any inclination to strain, and is fixed in place by a T-bandage. This outer dressing can be replaced later by a sanitary towel only. A suppository containing morphin may be employed. In forty-eight hours the first dressing should be removed, the part well washed, and redressed. The dressing consists of a folded piece of lint or of gauze firmly packed in the wound. It may be moistened with oil, or with iodoform or other ointment, or may be merely dusted with iodoform. The whole of the gap or gaps made by the operation must be well and carefully stuffed from the bottom.

The part should be dressed night and morning and after each action of the bowels. Scrupulous cleanliness must be insisted upon. A hip-bath may be taken daily after the action of the bowels. The bowels should at first be kept confined, but should be opened by means of a dose of castor oil on the third or fourth day. It must be seen that they act regularly after this. The discharge will be free for about the first ten days. The dressing may need to be changed from time to time, and the lint may be soaked with zinc sulfate lotion, with a silver nitrate solution, with the compound tincture of benzoin, with weak iodin, or with such other drug as the surgeon employs in like cases.

The parts may be overdressed and the skin around be kept in a condition of irritable inflammation. Every care must be taken that the skin does not heal over prematurely, and a constant watch must be kept for burrowing sinuses and for undermining of the skin. Pockets for pus soon form, and good drainage should be maintained throughout.

The diet should be simple, but not meager. Every means should be taken to improve the general health.

The operation will probably require, in an ordinary case, confinement in bed for some fourteen days, followed by another week or so in the house. In a complex case, with many deep sinuses, the after-treatment may extend over many months. Rest is all-important, and the healing process is very distinctly retarded by too early movement. Change of air will often do more for an indolent sinus than will the

most elaborate dressing. Some loss of power over the sphincter will be noticed for a little while. It is generally regained within three weeks. A permanent weakening of the anus may result, but it is very uncommon.

The treatment of fistula by the elastic ligature was at one time extensively employed. It is attended by no hemorrhage, and was recommended for cases of deeply extending fistula. The ligature is made of a solid cylindric rubber cord, one-tenth of an inch in diameter. One end of the loop is introduced along the sinus by means of a special director, while the other end hangs in the rectum. A pewter ring is then threaded over the two ends, and as the ligature is drawn tight, the ring is made to clamp the two cords by compressing it with necrosis forceps. The ligature is allowed to cut its own way out. This it will effect, on an average, in six days. There is little to recommend the measure, which is attended by no little pain. In individuals suffering from hemophilia, I imagine the risks of bleeding would be as great after the use of the ligature as of the knife. It has not been shown that the after-treatment is shortened by this method.

URETHROTOMY.

General Remarks.—After operations upon the urethra the former custom of allowing the catheter to remain has been abolished largely, for the reason that it is not only uncomfortable to the patient, but frequently produces urethritis; nor is it essential that a drainage-tube should be introduced into the perineal opening. The best plan is to allow the wound to remain open and have the urethra irrigated several times a day with warm Thiersch's solution and have the perineal wound kept thoroughly clean by the same means. By the use of proper antiseptics the urine is soon made aseptic, which tends to keep the part free from infection. A full-sized sound should be passed every three or four days until the urethra is healed. A pad is usually placed between the knees and the limbs kept together by means of broad bandages to prevent the careless spreading of the thighs. Should an abscess or swelling form in the region of the perineum, which is usually accompanied with severe pain and symptoms of acute suppuration, it must be evacuated through the perineal incision, being careful not to injure either the rectum or the urethra, and after thorough evacuation the cavity should be tamponed with iodoform gauze. The opening in all cases should be made large enough to insure permanent drainage.

Some surgeons prefer to open prostatic abscesses into the rectum to avoid infection. If, however, the perineal incision just described has been made, and if the patient has received proper preliminary treatment, consisting of a thorough laxative and flushing of the bowels previous to performing the operation, the perineal method is preferable. The administration of saline laxatives daily and thorough flushing after the evacuation of the bowels tend to render the patient more comfortable and the results more satisfactory. The patient should be placed in bed on his back, with some absorbent material under his buttocks to catch the urine; his thighs should also be protected

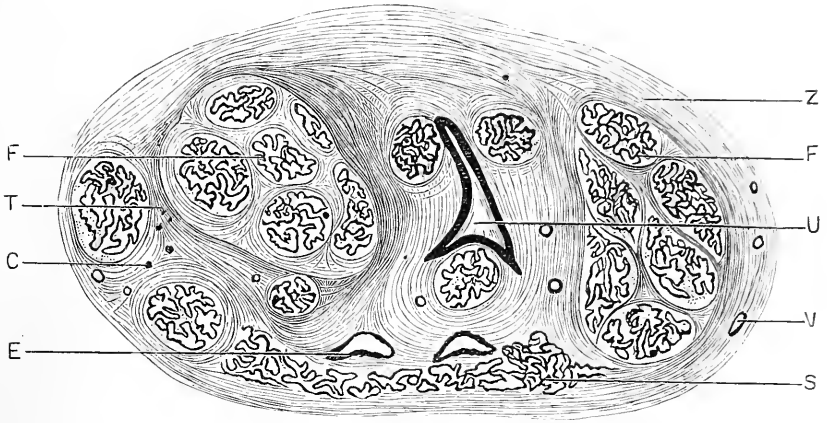

FIG. 75.—SECTION OF HYPERTROPHIED PROSTATE.—(*Duplay and Reclus.*)

U, Urcthra; E, ejaculatory ducts; T, fibrous tuberculæ; C, prostatic nodules; Z, fibromuscular capsule; V, periprostatic veins; F, fibroglandular tissue; S, section of seminal vesicles.

from the irritation caused by the urine by means of benzoated zinc oxid ointment and by frequent sponging with alcohol or boric acid.

Immediate suture of the perineal wound has been tried, but experience shows that it is attended with great risk; the deep portions of the wound, which have been more or less bruised by instruments, may slough slightly or heal more slowly than the skin-surfaces, and in this event extravasation of urine is likely to occur; whereas if the wound be allowed to close slowly, healing begins at the bottom. After perineal lithotomy the patient should remain in bed for from two to four weeks, except in cases of children, who recover very rapidly after the operation.

Internal Urethrotomy.—Should hemorrhage occur after internal urethrotomy, an ice-bag should be applied to the perineum with elevation of the pelvis, or a full-sized catheter (flexible, if possible) may be passed and left in, while a firm pad of wool is fixed against the perineum by a T-bandage. The catheter should be kept clear, and the urine should run continuously through it and an attached rubber tube. An opiate should be given if there is pain or restlessness.

In order to keep the cut surfaces from growing together, a sound should be passed every day for the first week, and subsequently every second or third day. Later, the passage of the sound need take place only once a month, but there is always danger of contraction unless a sound is passed at intervals.

To avoid rigors after internal urethrotomy, the patient should be kept thoroughly warm in bed, should not try to pass urine for a few hours, and should drink freely warm water or weak tea. Should a rigor occur, it should be met by the immediate administration of 10 grains of quinin in hot brandy and water.

External Urethrotomy.—When clamp forceps have been used and left *in situ* to control hemorrhage, they may be removed safely in thirty-six hours. General oozing is then controlled by firm pressure with iodoform gauze packed into the wound and around the drainage-tube or catheter.

The most important indication after urethrotomy is not only thorough drainage from the bladder, but every effort should be made to prevent the urine from coming in contact with the freshly made wound until septic absorption is guarded against by the formation of granulations. This is ordinarily accomplished by carrying a large rubber drainage-tube or No. 30 French catheter through the wound into the bladder and stitched to the wound to prevent its being forced out. Iodoform gauze is then carefully packed around the catheter. The end of the drainage-tube or catheter is then attached to a large tube which drains into a urinal, or if desired, a vessel on the floor.

The gauze packing should be removed from around the tube in forty-eight hours and the wound irrigated with hydrogen dioxid and carefully repacked. The bladder should also be irrigated thoroughly at least once a day with Thiersch's fluid. About the seventh to the tenth day after the operation, when granulations are formed, the drainage-tube should be removed from the wound and a curved sound passed into the bladder. The sound is passed every second or third

day into the bladder until the perineal wound is healed, when the patient may be discharged. Should a stricture also exist in the anterior part of the urethra, it may be divided by internal urethrotomy, after which a large straight sound should be passed through the meatus and anterior urethra down to the drainage-tube or posterior perineal opening. This should be repeated every alternate day until the drainage-tube has been removed from the wound and bladder.

From the first the patient is placed upon a light diet and directed to drink freely of water and milk to dilute the urine. Five-grain doses of urotropin thrice daily may also be given as an antiseptic. After the first forty-eight hours the patient may be allowed to assume a sitting position in bed, and a week after the operation may be permitted to sit in a chair. On closure of the perineal opening the patient usually has the ability to retain the urine in a normal manner. Stricture is almost certain to take place unless the patient passes a sound at intervals. He should, therefore, be taught how to do this without injury, and the fact of its neglect must be earnestly impressed upon him so that he may not neglect the precaution.

Postoperative Infiltration or Extravasation of Urine.—Postoperative infiltration or extravasation of urine may occur as a result of too rapid healing and failure to keep the urethra well dilated. Obstruction of the drainage-tube by means of blood-clot or faulty dressings, and attempts of the patient himself to void urine by straining and pressure, may cause a rupture of the thin walls of the urethra, and the urine may thus escape into the cellular tissues. It occasionally happens after operations for stricture; premature closing of the wound or attempts at the introduction of a catheter or sound may result in a false opening in the posterior urethra, and extravasation follow.

When, as is frequently the case, the extravasation occurs in front of the subpubic ligament, the urine burrows through the cellular tissue of the scrotum and penis, and extends upward toward the hypogastrium. Abscess rapidly forms, the tissues become gangrenous and slough, and spontaneous evacuation of the pus and urine occurs, with considerable destruction of tissue, leaving urinary fistulas. The septic condition is always very pronounced, and such patients usually die unless an operation is performed promptly.

When the rupture of the urethra takes place posterior to the subpubic ligament, the burrowing of urine takes place in a different di-

rection. In this case the urine cannot make its way forward through the cellular tissue of the penis, but it burrows under the deep layer of the perineal fascia and accumulates in the prevesical space, forming a swelling above the symphysis. From this point it extends, and inflammatory swelling and suppuration of the connective tissue within the abdomen occur and the patient dies of pyemia.

Treatment.—Urinary extravasation demands immediate operation in order to save the patient's life and prevent extensive sloughing and loss of tissue. An external incision should be made and the bladder drained through a catheter in order to prevent further escape of urine into the tissues. The collections of pus and urine in the tissues, no matter where located, should be opened up, drained freely, and packed with gauze. If the prostatic urethra was ruptured behind the subpubic ligament and extravasation has taken place into the prevesical space, the pus and urine should be evacuated by means of a suprapubic cystotomy.

AFTER-TREATMENT IN REMOVAL OF THE PROSTATE AND OF THE PROSTATIC URETHRA.

Moynihan's Method.—Moynihan gives the following directions: "The catheter is passed after the removal of the organ, and the bladder freely flushed with hot, sterile saline solution or a hot 1 percent solution of carbolic acid. When the fluid returns almost clear, a large rubber tube is passed into the bladder, and a couple of stitches introduced into the wound. There are often severe paroxysms of pain for a few hours after the operation, but they are relieved by morphin. At the end of forty-eight hours the tube is removed from the bladder, and the patient allowed to sit up with a bed-rest. On the fourth day and each succeeding day a catheter is passed and the bladder freely washed with dilute carbolic-acid lotion. On the seventh day the catheter is tied in and a drag placed on the suprapubic wound, which is removed every morning and the bladder again flushed. The catheter is not removed for five or six days; a new one is then introduced. The patient is allowed to get up and sit in a chair at the end of the first week if he is a feeble old man. The urine ceases to come through the wound about the end of the third week, and at the end of the fourth or occasionally not until the end of the fifth, the patient is passing urine spontaneously at natural intervals, and the wound is entirely

closed.'' If there has been a cystitis, he orders urotropin or helmitol, 10- to 15-grain doses three or four times daily.

Suprapubic Prostatectomy.—No attempt is made to sew up the bladder wound, the two stitches inserted into each edge being secured to the skin. A large soft-rubber tube is then inserted and fixed by a stitch; a large absorbent dressing is now applied over the pubes, and retained by a many-tailed bandage. The whole of the urine escapes through the wound for two or three weeks, and very frequent change of dressings and constant attention to cleanliness are required on the part of the nurse.

The bladder should be gently washed out every day with a warm aseptic solution. The tube and stitches may be removed in two or three days' time. About two to three weeks after the operation the urine begins to pass through the urethra, and this should be favored by keeping the patient in the sitting posture and getting him out of bed as soon as possible.

If the entire obstruction has been removed, the bladder will regain control in from a month to six weeks after the operation. The condition of "vesical atony" which was supposed to be present in many cases of prostatic enlargement appears to have no real existence. (Freyer.)

Perineal Prostatectomy.—The open-wound method is preferable when the perineal operation is performed, but in severely infected bladder cases Ochsner recommends the introduction of two drainage-tubes well up to the fundus of the bladder, so that irrigation may be accomplished by injecting fluid through one tube and permitting it to escape through the other after the operation. When there has been considerable hemorrhage from the capsule and hemostatic forceps have been applied and allowed to remain and protrude through the wound, they can be safely removed after twelve to twenty-four hours, or if there has been considerable oozing, the space around the drainage-tubes may be tamponed with a sufficient amount of iodoform gauze, and in this case the gauze should be removed on the third or fourth day. In all cases the bladder should be irrigated with normal salt or boric-acid solution, from one to six times a day, according to the condition of the bladder. After the sixth to the tenth day the rubber drainage-tube should be removed. At this time the patient will ordinarily have no difficulty in evacuating the bladder normally, but in case the flow of urine is not normal, a soft-rubber catheter should be introduced

through the urethra into the bladder for a few days. The patient should be encouraged to sit up the second or third day after the operation, for the reason that elderly men do not bear confinement well.

The Scrotum.—For the removal of cancerous or tuberculous tumors all superfluous scrotal tissues should be removed, and after removal of the testes all bleeding points clamped and tied. Oozing into the scrotum gives rise to much trouble on account of the laxity of the tissues, and the long time it requires for clot to become absorbed, and the liability to infection. As scrotal tissue usually swells rapidly, care should be taken that the stitches be not too tightly drawn. Drainage is always essential in scrotal operations, the postoperative treatment being the same as that of other open wounds, drainage being necessary for at least forty-eight hours.

In patients advanced in years the postoperative shock is sometimes considerable, hence the operation should be performed with as little traumatism as possible, and frequently an inguinal incision only should be made.

Epididymitis sometimes occurs as a complication after an operation upon the scrotum. It is usually manifested by severe pain, a chill, followed by fever, rapid enlargement, with edema of the scrotum.

Treatment.—Rest in bed; saline purge; wrap testicles in lead-water and laudanum and elevate with handkerchief bandage; hot compresses and hot-water bag to inguinal region; properly fitted suspensory bandage strapped in recumbent position over thick sheet of absorbent cotton or wool; in severe cases puncture vaginal tunic and cellular tissue at back of scrotum (introduce knife not deeper than one-half inch) and then apply suspensory bandage or elevate testes with handkerchief; keep testicle constantly wet with lead-water and laudanum on lint or a 10 percent solution of iodoform in glycerin; morphin hypodermatically if pain is severe; later incise if pus is suspected, and drain with iodoform gauze; strapping or suspensory bandage after acute symptoms subside, followed later by application of ointment of iodoform 1 part to 7 parts of belladonna ointment.

CASTRATION.

General Considerations.—The skin incision should be carried to the bottom of the scrotum, in order to secure good drainage. It may, however, be noted that the higher up the incision is placed, the

more easy is it to avoid septic contamination, and that unless the testis is of great size, it is possible to remove it through a moderate incision made near the external ring. The bottom of the scrotum may then be drained for twenty-four hours through a separate puncture.

When the skin is implicated by the disease, the incisions should extend beyond the diseased area and involve sound skin only. It is not necessary to remove redundant skin, unless it be excessive in amount and much atrophied. If any sinuses be left behind, as after the removal of a tuberculous testis, they should be most carefully scraped with a Volkmann's spoon. The cord should be secured about one inch from the testis. If it be involved, it should be divided higher up. It can seldom be necessary to open up the whole inguinal canal to secure the cord, as advised by some. If the disease has extended to the external ring, the expediency of any operation may be questioned. Before the cord is secured and divided the anesthetic may be discontinued for a while, as the section is sometimes attended by a very marked and sometimes alarming sinking of the pulse.

It must be remembered that the cord is very much dragged down by a large growth; and if secured very high up, the stump, after section, may be withdrawn beyond easy reach when the heavy tumor is removed.

The chief bleeding to be feared after castration is venous rather than arterial. It is unwise to include the entire cord in one ligature; the vessels are not well secured by this means. The loop of thread may slip off when the clamp is removed. A substantial ligature (if single) must be employed, and it may excite suppuration until it is discharged. Secondary hemorrhage may follow the loosening of the single ligature. Neuralgia of the cord may also attend the procedure.

The same objections apply, but in a less degree, to the practice of transfixing the cord with a needle and ligating it in two segments.

Sometimes a tuberculous or syphilitic testis has to be operated on in which suppuration has already supervened, and the parts are thoroughly septic. In such a case, although all possible precautions are taken at the time of the operation, the surgeon can hardly hope for primary union, and free provision for drainage should be made. In nearly all cases of tuberculous orchitis the vas is invaded with tubercle bacilli along its whole course by the time the patient consents to operation. Owing to this fact, a troublesome complication after simple castration is the development of a secondary lump or abscess

around the severed end of the vas. This may occur weeks or months after the wound has apparently healed. Partly to avoid this, and also to make a complete clearance of all the tuberculous disease, the plan has been carried out of removing the lower end of the vas and the corresponding vesicula seminalis by the perineal route, while the other end is pulled away with the testis through an incision prolonged into the inguinal canal. Reverdin and other surgeons have proved that it is thus possible to remove the whole length of the vas, but the proceeding is one of considerable difficulty and of very doubtful value. The perineal part of the operation, conducted through a curved incision made in front of the rectum and across the median raphe, is similar to and even more difficult than perineal prostatectomy. The vas and vesicula have to be reached at the bottom of a deep and narrow wound, there is apt to be most troublesome venous hemorrhage, and there is some risk of damaging the bladder wall (to which the vesicula is closely bound by the rectovesical fascia) or the ureter. Finally, the wound is placed very badly for aseptic purposes. To drag the greater part of the vas deferens out through the inguinal canal is also a rough and hazardous procedure. When it is added that tuberculous disease of the vesical neck or prostate is often present with disease of the vas deferens, and that spontaneous recovery from both is not infrequent, the arguments in favor of combined perineal and inguinal operations are seen to be but feeble. The operation was described in the "Gazette des Hôpitaux," October 15, 1898, and also in the "Bull. de la Soc. Anatomique," 1898, p. 603.

Erasion of the Tuberculous Epididymis.—In removing the whole organ the surgeon is often taking much more than is actually diseased, for in the majority of cases the testis proper will be found to be free from tubercle. It is the epididymis and the vas which are involved with so-called "crude tubercle," while occasionally the testis becomes affected with miliary deposit. Hence a very thorough erasion and excision of all the tuberculous foci will often suffice, and the testis itself may be safely retained. We have known cases in which the whole epididymis and several inches of diseased vas deferens were excised, the testis remaining for years of normal consistence and size. Some importance is to be attached to the retention of the "internal secretion" of the testis.

The erasion must be effected through a free incision, the testis being turned out and the tunica vaginalis being laid open. Every

particle of tuberculous tissue should be cut or scraped away, and if the vas is diseased, it also should be dealt with. Care should be taken not to damage the main vessels of the cord, and if this be avoided, the hemorrhage will only be slight. Finally, the testis and its vessels are replaced in the scrotum, and a small drainage-tube left in the wound for a few days.

After-treatment.—The scrotum is well slung up by a light roll of loose gauze applied as a suspender. This gauze clings to the skin better than any other dressing. The wound may be then dressed with a sponge dusted with iodoform, or with a pad of Tillmann's dressing packed all around with gauze, and secured by means of a T-bandage or a spica. If this be properly applied, the sponge or pad exercises firm but gentle pressure upon the wound. The drainage-tube should be removed in twenty-four hours, and the dry dressing continued. In the first twenty-four hours after the operation retention of urine may exist. The scrotum is easily inflamed by the use of irritant lotions —*e. g.*, strong carbolic solutions.

Should suppuration occur, constant care must be taken to prevent bagging. The sutures are removed on the fifth to the seventh day. The patient will probably complain of the hard, tender swelling which usually appears at the external ring, and which is due to inflammatory changes in the stump of the cord. As the wound heals, the cicatrix becomes depressed, from the obliteration of the scrotal pouch. If primary union be not obtained, the edges of the wound may need to be retained in contact by strapping.

Comment.—In some cases the descent of a hernia after castration has forced open the wound, the rupture having been previously kept up by the enlarged testicle. During the operation, moreover, hernial sacs have been inadvertently opened up. If a scrotal hernia exists, the rupture should be reduced, the sac excised, and its neck ligated, the same as for the radical cure of hernia.

HYDROCELE.

Open Method of Treatment.—An incision through the skin and into the tunica vaginalis, preferably suprascrotal or in the lower inguinal region, sufficiently large to permit the introduction of drainage, is made, and before the escape of all the fluid the cavity is packed gently with iodoform gauze as high up toward the external ring as

possible. A small gauze drain is also introduced downward into the scrotum, over which the ordinary dressings are applied and held in place by a suspensory bandage. The gauze drainage after the fourth day is gradually removed and the wound allowed to heal by granulation in from seven to ten days.

CIRCUMCISION.

After-treatment (Cheyne).—When the separation of the prepuce from the glans does not give rise to a raw surface, after using fine catgut sutures, the simplest plan is to dry the line of incision, lay a little salicylic wool over it, and fix it in position with flexible collodion, which dries quickly and may be left for a week. The patient should then be placed in a sitz-bath about a quarter of an hour before the surgeon's visit. The dressings may then be peeled off without causing much pain. Any raw surface remaining may have a small fresh dressing applied to it. However, when the surface of the glans is left raw, a better method is to wind a strip of wet boric-acid lint around the line of union, while outside of this a large layer of wet boric-acid lint is applied, so as to cover the whole penis and scrotum, and this is covered with oiled silk or jaconet and kept in position by a T-bandage. The outer dressing is changed repeatedly for several days until the parts are healed. After the first three days the inner layer of boric-acid lint may be soaked off and a narrow strip saturated with boric-acid ointment may be applied in its place. If silk or other nonabsorbable sutures are used, they may be removed on the fifth to the seventh day.

Bransford Lewis' method of after-treatment, which we have employed several times with success, is as follows: After cleansing and drying the penis, it is encircled loosely with a piece of cotton inclosed in a layer of gauze. This is then thoroughly saturated with compound tincture of benzoin applied with a medicine-dropper. On drying, this dressing becomes moderately firm, forming, as it were, an antiseptic splint. A Teufel support bandage is put on, which holds the dressings in good position. The dressing is renewed after three to five days. In eight days the parts are usually securely healed and all dressings are removed, except possibly some mild dry dusting-powder. With this form of dressing in adults it is not necessary for the patient to suspend work or lay up after the operation, but they are directed to continue in their usual employment.

CHAPTER XIV.

MISCELLANEOUS OPERATIONS.

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LIGATION OF ARTERIES.

Operations for ligation of arteries are usually performed under strict asepsis, and under such circumstances the after-treatment of the wound presents nothing different from ordinary aseptic wound treatment. In case of the main artery of an extremity, the limb should be kept absolutely at rest and be a little raised. The arm should lie outstretched upon a pillow, the lower limb raised upon an inclined plane. The whole extremity is enveloped in cotton wool and is kept warm by hot bottles. In case vessels the size of the iliacs, the subclavian, or the common femoral are ligated, absolute rest should be enforced for a period of not less than twenty-one days.

The time involved in the after-treatment of cases in which smaller vessels have been ligated may be regulated in proportion. The period of compulsory rest should be longer in old subjects than in the young, and in cases in which the lower limb is concerned than in the upper.

ABSCESSES.

General Considerations.—When pus collects in any cavity or new formation in the body, in a recognized quantity, such collection is called an abscess. If it be well defined, held in position by a limited wall or membrane, it is a "circumscribed abscess," and when infiltrated in the tissues it is called "diffuse." A rapid recent collection of pus is called an acute abscess, a slow-forming or chronic collection, with little or no inflammatory reaction, is called a cold abscess. (Wyeth.)

The distinct characteristics of the various sorts of abscesses depend upon the character of the pus and the location or character of tissue in which they are formed. The amount of pain in purulent inflammation differs greatly: in some cases it is intense, in others entirely absent, depending largely upon the tissues or amount of nerves in the part affected. The amount of pain also depends upon the rapidity with which the abscess forms. If the pus accumulates rapidly, the pain will be more intense; if slowly, the tissues become accustomed to the distention.

General impairment of the circulation, general anemia, or other systemic conditions—such, for instance, as diabetes—increase the tendency to suppuration and markedly interfere with recovery.

General Treatment.—When acute abscess exists, whether circumscribed or diffuse, it should be freely evacuated. The point of greatest importance is to have the opening or openings in such position that drainage from the most dependent portion of the cavity is accomplished. Thorough drainage is indispensable. So soon as the abscess is opened the cavity should be thoroughly but gently irrigated with a solution of 1 : 3000 mercuric chlorid, lysol 1 percent, or a saturated solution of boric acid, after which rubber or gauze drainage should be inserted, the treatment thereafter being similar to that of open treatment of septic wounds. It should be remembered, however, that gauze drains pus but poorly, and in many instances a rubber tube for drainage is better.

Tuberculous or cold abscess, in case there is no deformity or marked discomfort to the patient, may be left unopened. When for any reason it is considered best to incise a tuberculous abscess, it should be performed under the most strict asepsis, and the cavity, partly filled with an emulsion of iodoform and glycerin, should then be closed and hermetically sealed.

Some surgeons prefer to evacuate all tuberculous abscesses with an aspirator instead of incision. When this is carefully done to the exclusion of air, particularly in small abscesses, and with the thorough cleansing of the abscess, constitutional disturbance is rare. Should, however, inflammation and suppuration follow, free incision should be practised and thorough drainage established.

Pulmonary Abscess.—Incision and Drainage.—Where the visceral and parietal layers of the pleura are not adherent, the simplest way of securing approximation of the two layers is to unite them by a series of local stitches, the same as is employed in ordinary needlework. Fine catgut sutures should be used, and these should be inserted before the pleura is opened. As a rule, however, the lung is consolidated in cases of pulmonary abscess and the tissue so adherent that they do not fall away from the fixed wall to any material extent. After the evacuation of the pus the cavity should be swabbed out with a solution of zinc chlorid (40 grains to the ounce). A large-sized drainage-tube should then be introduced into the cavity, and packed fairly firmly around with iodoform gauze. The tube should be large

enough to exert sufficient pressure from the lung tissue surrounding it to check oozing. The wound is left open and a large dressing applied. The tube should be left in position three or four days, until its track is well established; it should then be removed, washed, and replaced, or a gauze drainage substituted therefor. The abscess cavity should not be irrigated, but insufflation of iodoform or boric-acid powder may be practised at each dressing. The tube or drainage should be retained until the discharge is mucoid in character and all expectoration has ceased. It is important always to secure the drainage-tube in position by means of a safety-pin, lest it slip into the pleural cavity and necessitate an additional operation. Neglect that would lead to such disastrous results is little short of criminal, but instances in which this has occurred are too plentiful.

Retrorectal Abscess.—A semicircular incision between the anus and coccyx is the best in these cases. After thorough evacuation the pus-cavity should be washed out with hydrogen dioxid, followed by 1 : 2000 mercuric chlorid solution. The sphincter should always be stretched after the abscess cavity is evacuated and the stools kept regular but not loose. As to drainage for these cases, a double rubber tube is preferable to gauze. Frequent irrigation with antiseptic solutions is very important. If the abscess wound exhibits a sluggish tendency and the abscess does not heal as rapidly as the general condition would indicate, the tube should be removed and the cavity swabbed out with 95 percent carbolic acid or pure ichthyol. If the latter is used, the better plan is to saturate a narrow strip of gauze with the drug, which is then introduced into the cavity and left for two or three hours. It should then be removed and the drainage-tubes introduced. Patients may be allowed to walk or stand upon their feet, but sitting should not be allowed until the abscess has practically healed, as this posture interferes materially with the circulation and drainage of the parts. Tonics, good nourishing diet, and such medication as seems indicated should be employed.

Psoas Abscess.—In the method of Sir Frederick Treves a tube of a Leiter's irrigator is introduced into the center of the abscess, and, the cistern being placed at a height of four to six feet above the level of the table, a large stream of the mercurial solution or warm water is allowed to run through the abscess. During this process of irrigation the abscess is frequently emptied by pressure applied to it from the front, and is allowed to fill again and to be emptied again. The

patient's position, also, is altered many times. He is turned over toward the sound side, and is then turned almost upon the back, in order that every part of the abscess sac may be well and vigorously flushed.

The surgeon now proceeds to remove as much of the lining membrane of the abscess as is possible. The finger is the safest and most useful instrument. It is introduced as far as possible. Diverticula from the main abscess are opened up, collections of caseous matter are scraped away with the nail, and here and there the action of the finger may be helped by a sharp spoon. This instrument, however, must be used with caution. It causes bleeding, and often produces a needlessly extensive raw surface. Moreover, the anterior wall of the abscess cavity is usually thin, and the steel instrument may inflict a serious injury upon that part of the parietes.

Next to the finger, the most valuable means of clearing out the abscess cavity is a piece of fine Turkey sponge held in a slender, long-bladed holder. This should be passed in all directions over every part of the abscess wall. The wall should be literally scrubbed with it. It should be gently bored by a rotatory movement into every pocket and diverticulum. The sponge must be changed very frequently.

After a vigorous use of the finger and sponge, the irrigator is again brought into action, and the abscess cavity is once more flushed out, and such débris as the sponge has left is swept away. Once again the finger and thumb search out all the recesses of the abscess, and once again the stream from the irrigator follows. This is done until the abscess cavity appears to be clean, and until the sponge is returned practically unsoiled. The process is slow and tedious, but it is very effectual. It leaves the abscess cavity bare, and freed entirely of the curdy pus, of the caseous masses, and of the ill-conditioned débris which filled it.

Finally, the interior of the abscess is wiped dry with the last set of sponges used, and the wound is closed by a series of silkworm-gut sutures, passed sufficiently deep to include the greater part of the muscular and tendinous structures with the skin.

A pad of dry gauze or of wool dusted with iodoform is placed over the little wound, and is secured in position by a broad flannel bandage.

After-treatment.—The subsequent treatment consists in absolute rest in the recumbent position for a period of months—a period which may easily be too short, but hardly too long. The actual number of months during which the recumbent posture should be observed

must depend upon the nature, extent, and stage of the disease. In adults it will probably extend beyond six months in the hands of those who wish to exercise a wise caution. It is not the abscess which is in need of treatment—it is rather the diseased condition which has produced it.

If the period of rest can be carried out at the seaside, and the patient spend the greater part of the time out in the open air (winter and summer) in a spinal carriage, so much the better.

The abscess may refill, and may need to be evacuated, washed and scrubbed out, and closed a second time.

In no case have I had occasion to carry out a third operation. If the wound should break down and pus escape at the site of the incision, free drainage and a most liberal irrigation must be the plan of treatment. This has occurred in a few of my cases, and in every instance the patients who have been the subject of this complication have done well. The wound, even in these cases, will heal by first intention, and signs of pus beneath the surface will usually not be observed until a fortnight or more has passed by.

Barker has employed in these cases an ingenious instrument, which he terms the hollow or flushing curet. It consists of a curet with a tubular handle and shaft, through which water can be conducted into the hollow of the curet. The water, running continuously through the instrument, washes away all débris as soon as it is loosened by the sponge.

Technic.—The *modus operandi* is thus described*: A two-inch incision is made through sound structures over the lower end of the swelling. Through this opening a hollow gouge is inserted, which is connected with a reservoir of hot water at 105° to 110° by a rubber tube some six feet long. This reservoir (a three-gallon can) is raised about five feet above the operating table. When the water is now turned on, it rushes through the long gouge to the fundus of the abscess with considerable force, and the reflux carries the contents of the cavity out by the incision. By gentle scraping with the flushing-scoop the more solid caseous matter is dislodged, the hot water carrying it clear of the cavity at once. Then the walls of the cavity are gently scraped in a methodic manner until the soft lining is loosened and carried away from every part of the abscess. In order to effect this thoroughly, the scoops are made of

* "Brit. Med. Jour.," Feb. 7, 1891.

varying length, so that the deeper parts can be reached. With hot water the bleeding is but slight if the peeling be done cautiously.

When the water runs out clear after having been carried to all the recesses of the cavity, the instrument is withdrawn. Then any excess of water is squeezed out; and if the deeper parts are accessible, sponges are used to dry out the last traces of moisture. Then two or three ounces of fresh iodoform emulsion is poured into the deepest part of the abscess, and stitches are inserted in the edges of the incision. Before these are knotted, all excess of emulsion should be squeezed out of the cavity. The knotting of the silk sutures then completes the procedure. As no drain-tube is used, a simple dry dressing of salicylic wool is alone required; but it should be laid on in considerable quantity, so as to exert elastic pressure over the whole area of the abscess when bandaged. Such a dressing may be left on for about ten days, when it is time to remove the stitches, and the wound should then be firmly healed. A piece of salicylic wool secured by collodion at the edges should, however, be laid over it, to keep it from chafing, for a few days longer, and the elastic pressure also should be kept up.

BUBO.

Technic.—When suppuration is marked, the pus should be evacuated by free incision, and at the same time all portions of the glandular structure should be removed by means of careful dissection or a sharp curet. The wound is left open and packed with iodoform gauze and allowed to heal by granulation. It requires from two to four weeks ordinarily for the wound to heal.

Considerations of Time.—Surgeons disagree as to the proper time of extirpating or incising the gland. The majority prefer to wait until suppuration is well marked and the gland is entirely broken down before any incision is made. For this reason Krulle advises the application of hot fomentations till the gland is entirely broken down, when the pus is evacuated through a small incision. Every second day the pus is then squeezed out and the cavity of the wound washed with a 1 percent solution of silver nitrate. Under this treatment the patient can walk about and thus avoid the necessity of lying in bed. This method is only applicable to cases in which the glands break down rapidly, but in many instances suppuration goes on slowly, in which case it is better to make a free incision, evacuate the pus, and remove by curetment the broken-down remains of the gland. When healing is delayed, general

tonics are indicated, and the local use of balsam of Peru or ichthyol applied upon the gauze packing may prove of great benefit.

Hayden waits until pus forms, then through a small incision squeezes out the pus, washes the cavity out with hydrogen peroxid, then flushes out with a bichlorid solution, injects warm iodoform ointment, and dresses with cold moist bichlorid gauze to congeal the ointment.

EXCISION OF THE GASSERIAN GANGLION.

Postoperative Treatment.—In a prolonged and difficult operation of this kind faults in asepsis are apt to creep in, as shown by the fact that

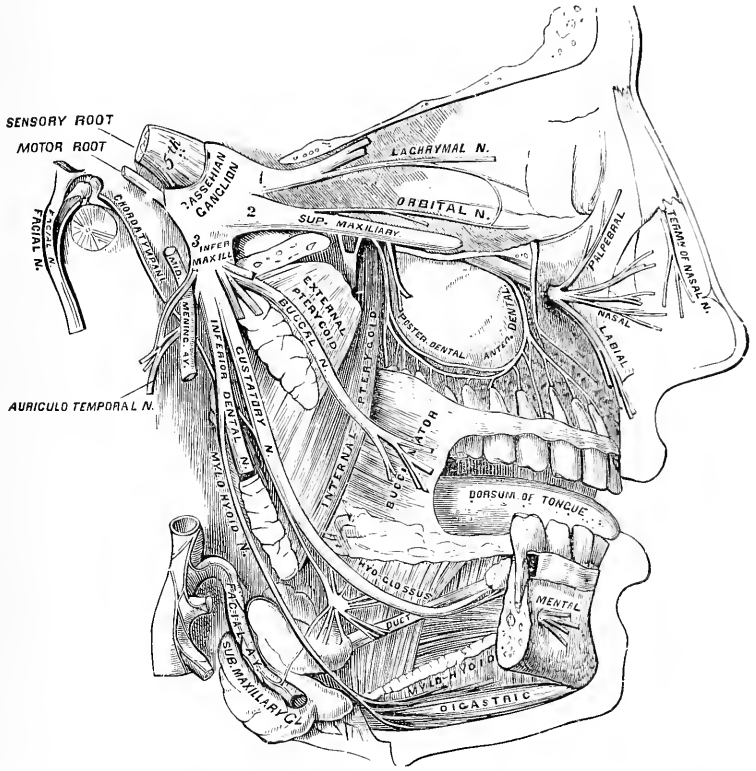

FIG. 76.—SHOWING LOCATION OF GASSERIAN GANGLION.—(*Holden.*)

about half the fatal results are due to septic meningitis. At the end of the operation, therefore, the wound should be gently flushed with a weak warm antiseptic solution. There is always much oozing during the operation, and nothing could be worse than the collection of blood

between the dura and the flap. Hence, whether the large trephine has been used or the osteoplastic method, provision should be made for drainage during the first forty-eight hours, and the patient's head should be turned on the affected side. A small piece of iodoform gauze, removed in two days' time, will suffice. The head must be enveloped in a light dressing of sterilized gauze and wool, and for securing it an elastic bandage is useful, or a modified Barton or recurrent bandage (Wharton) may be employed.

The wound should heal in a week; but if bone has been replaced or the osteoplastic method employed (see Fig. 77), it may happen that necrosis will occur. If the ganglion is removed by avulsion or otherwise,

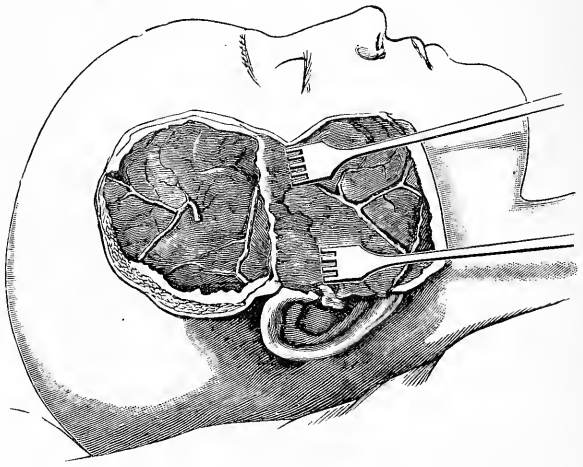

FIG. 77.—OSTEOPLASTIC FLAP TURNED DOWN, SHOWING DURA MATER, MENINGEAL ARTERY, EXPOSING GASSERIAN GANGLION, ETC.—(*Brewer.*)

it not only severs connection between the root and the second and third divisions, but also between the root and the first division as well. It then follows that the eye will be anesthetic, dryness, friction, and foreign bodies are not perceived, and abrasion, corneal ulceration, and loss of the eye may follow. Keen says to avoid this just before the operation is begun it is best to sew the eyelids together to protect the ball, the sutures being removed on the third day. A celluloid shield, similar to the vaccination shield, and devised by Keen, is then fastened in front of the eye by elastic, and is worn for a week or more, the eye being syringed daily with a warm boric solution.

For this reason, and also on account of the success of the operation,

limited to the two main divisions of the fifth nerve and the ganglion, the operator is advised to let the ophthalmic trunk and the ganglion alone; if this advice be followed, no precautions are required as regards the eye.

Postoperative shock may be considerable in these patients, who are usually aged and exhausted by their suffering, and it has accounted for nearly half of the deaths recorded. In overcoming it, adrenalin and strychnin injections, brandy and coffee enemas, and a warmth to the general surface are the chief remedies.

LAMINECTOMY.

In closing the wound when the cord has been exposed some surgeons prefer not to close the theca or outer covering of the cord, but leave it open in order to prevent pressure. If carefully sutured, however, it tends to prevent loss of cerebrospinal fluid, and if left open cicatricial adhesions of the soft parts to the surface of the cord may occur. A drainage-tube is usually placed in the muscular portion of the wound to carry off the wound fluids for the first twenty-four to thirty-six hours. Unless for very urgent reasons the drainage-tube should not remain longer. The muscles and subcutaneous tissues are usually approximated by buried sutures, and skin closed by silkworm-gut, and the usual antiseptic dressings applied and held in place by ordinary binders.

The position of the patient after the operation should be dorsal, which affords sufficient drainage and prevents escape of the cerebrospinal fluid. The limbs and body are elevated, and borated starch or zinc stearate should be liberally applied should the fluid discharges irritate the skin.

After-treatment.—On account of the abundant oozing both of the wound-fluids and possibly of the cerebrospinal fluid, the wound will usually have to be dressed within the first twelve hours, but after the first twenty-four hours not usually more than once in two or three days. The strictest antisepsis should be observed, lest infection should follow. This is particularly necessary, both during the operation and the after-treatment, if there are bed-sores, since they produce considerable foul discharge which may infect the wound. If the patient has lost control of the bladder and bowels, an additional source of infection exists, which will require great vigilance.

Thorburn has proposed to drain the bladder by suprapubic cystotomy after injury of the cord, to avoid the constant wetting of the wound,

and its infection through the incontinence of the urine. The suprapubic route is selected, inasmuch as these parts are not anesthetic and therefore not apt to slough. The suggestion seems to be very reasonable, but I have seen no report of it having been carried into practice. The bed-sores should be dressed with boric ointment, carbolated vaselin, or such other mild ointments. They often show very remarkable and early improvement, and not uncommonly heal entirely. Of course,

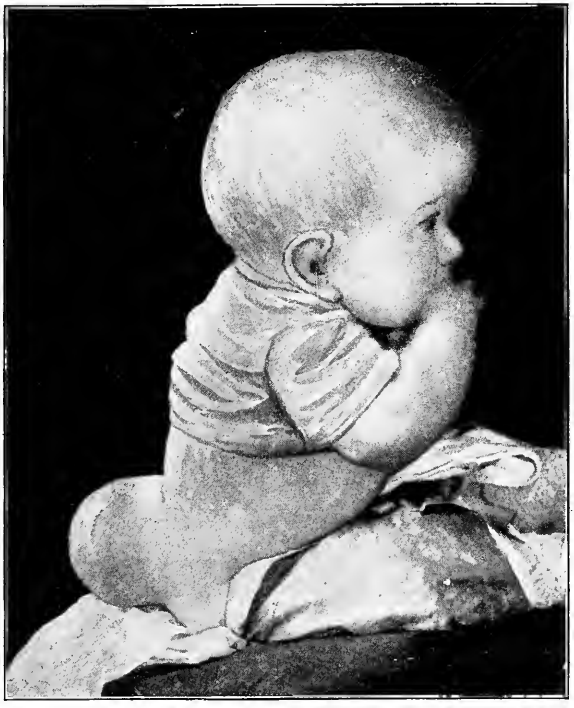

FIG. 78.—SPINA BIFIDA (ORIGINAL).—(*"American Text-book of Surgery."*)

the usual precautions as to food and drink must be observed, together with the use of opiates for sleep and such other symptomatic treatment as may be required. (Dennis.)

SPINA BIFIDA.

The radical cure of spina bifida is now more frequently attempted than formerly. The choice of methods for removal of the tumor by dissection, ligation, or excision must depend upon the size, local condi-

tion of the formation or growth, and the general condition of the child. If the tumor is large or the cord or cauda equina is involved, usually no attempt at removal should be made. Pedunculated cysts, where the opening in the lamina is small, may be safely removed. After removal or extirpation a double layer of iodoform gauze is placed over the wound, after which the entire wound and area well around the incision should be hermetically sealed by means of collodion and cotton. Over this at least two layers of rubber tissue should be placed and sealed to the skin about its edges with chloroform, and, lastly, over all a layer of cotton is placed, with plain gauze, and all held in position by a broad abdominal bandage.

The after-treatment of these cases is of vital importance. The child is placed in bed upon its stomach, with no pillow under the head. This position should be maintained for several days or weeks, or until thorough healing has so far progressed that all leakage of cerebrospinal fluid has ceased. Excessive loss of cerebrospinal fluid is manifested by sinking of the fontanels.

Nourishment with alcoholic stimulants should be administered freely, as death from exhaustion is of very frequent occurrence. Depressed fontanel, tetanic convulsions, however slight, preceded by vomiting, usually indicate a fatal termination.

HYPOSPADIAS OR ECTOPIA VESICÆ.

General Considerations.—Parker keeps his patients in a hip-bath of warm boric lotion throughout the whole of the after-treatment, with the result that almost complete primary union follows a flap operation. With care the position of the patient in a hip-bath may be made so comfortable that he will rest better in the bath than in the constrained and cramped position he must of necessity occupy in bed. The discomfort of lying upon a wet mackintosh is also not inconsiderable.

It is needless to say that the lotion in the bath must be maintained at an even temperature, and be constantly changed. Thiersch and others advise the use of a Compress* after the operation has been quite completed. This instrument is intended to occlude the newly made urethra, and to be removed when required.

It cannot be recommended, on these grounds: in the first place, the capacity of the new bladder is very small; and in the second place, the constant pressure of the instrument is capable of producing a slough or even a urinary fistula.

* An instrument devised for making pressure over the new-made urethra.

In the most successful cases a urinal cannot be dispensed with.

Results of the Operation Generally.—The results claimed in the most successful cases are that the raw surface of the bladder is protected and covered in, and that a urinal can be worn which will keep the patient quite dry. Many patients are free from the inconvenience of incontinence when they are lying down, but in no instance can it be claimed that the patient has acquired a control over the bladder. These results, however, are very satisfactory when the miserable condition of the patients before the operation is considered. (Treves.)

SYMPHYSIOTOMY.

General Considerations.—After the completion of the labor, the wound should be thoroughly cleansed with sterile water, and lastly alcohol. Three or four stout silk, silver-wire, extra large silkworm-gut, or preferably heavy kangaroo tendon sutures are used to hold in apposition the separated bones. The sutures should be inserted at least one-half inch from the margins of the muscular insertion, and should include all the fibrous tissue down to and including the periosteum. They are tied in the median line, cut short, or buried. The superficial incision may then be closed after the ordinary method, small rubber tissue drainage being indispensable.

The wound is dressed with several layers of iodoform cloth with a layer of Wood's or absorbent cotton, all of which are held snugly in position by means of a broad moleskin adhesive plaster passing around the pelvis immediately below the crest of the ilium, and extending down over the trochanters in order to retain the pelvic bones in apposition. The patient is now placed upon a gutter-shaped bed or mattress, with cushions under the lateral halves of the body. Jewett and others adopt practically the same method, using an ordinary hard mattress and keeping the patient on two firm cushions placed under the lateral halves of the pelvis and extending nearly to the shoulders.

Mechanical Aids.—An excellent apparatus for maintaining coaptation of the pelvic bones after symphysiotomy is Ayres' hammock bed. This consists of a canvas stretcher supported as shown in Fig. 79. The stretcher may be made more or less trough-like by adjustment at shorter or longer distances apart of the poles on which it hangs. A canvas slide wide enough to reach well above and below the pelvis is suspended by its ends from a second series of poles above the first. The patient rests with her pelvis in the loop of the sling, while the remainder of her body

is supported by the stretcher. It will be seen that the pubic bones are held firmly in apposition by the action of the sling.

The author has used an ordinary hospital bed with high frames and woven wire mattress to accomplish the same purpose. The stretcher bolts of the mattress in the center are loosened with an ordinary wrench. If necessary, the two outer bolts of the wire mattress may be drawn very tight. Over this is placed an ordinary cotton mattress. Two poles are then adjusted above the patient similar to the mechanism of the Ayres' bed (Fig. 79).

When the bed-pan is used, the greatest care must be exercised by the

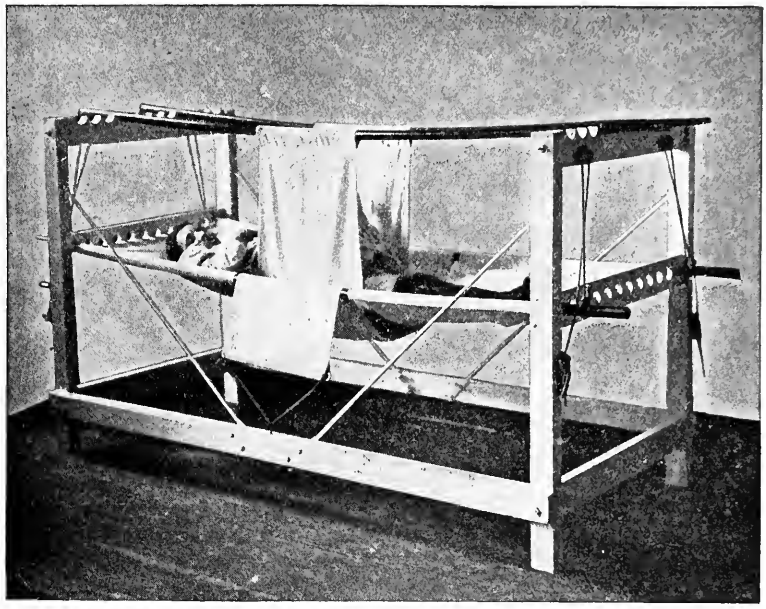

FIG. 79.—AYRES' SYMPHYSIOTOMY HAMMOCK, SHOWING PATIENT.—(*Jewett.*)

nurse to see that no movement of the bones is permitted. The sling in which the patient lies should not be removed, but the thighs may be gently lifted while the nurse slips the vessel beneath. The patient should remain in bed fully six weeks, the case being treated as in fracture of the pelvis. The pelvic support should not be discarded for three or four months after the woman leaves her bed.

TUBERCULOSIS OF THE JOINTS.

This condition is characterized by slow beginning, by its usual limitation to one joint, by the tendency to fixation of the joint, and, lastly, by the atrophy of the muscles both above and below the affected part. (Ochsner.)

Rest Cure.—It is of the utmost importance that the surgeon's attention be primarily directed toward the improvement of the patient's general condition, which can be best accomplished by improving the hygienic surroundings, the nutrition, and regulating the habits of life; and by administering tonics and concentrated foods and some form of creasote. Above all things, the patient should not be permitted to continue to live under the conditions which primarily gave rise to the disease. These points are of great importance, not only in obtaining a recovery from immediate disease, but also for the purpose of securing a permanency of cure. It frequently becomes necessary to change the dwelling of these patients, if not the climate, to change their food, to regulate their hours of rest, and frequently their occupation.

This accomplished, the treatment of the joint involved depends upon its location and the extent to which the disease has progressed. If in the incipient stage, rest alone, with the conditions described above, will frequently suffice to produce a recovery. (Senn.)

Mechanical Aids.—A light cast made of plaster-of-paris, very carefully constructed and strengthened by thin strips of wood-fiber, is usually the most desirable dressing, unless the patient can afford the use of similar dressings manufactured from aluminium. The cast should be applied over some elastic woven material arranged in a double layer in order that the friction of the cast which adheres to the outer layer will not be directly against the skin, but against the second layer which will remain free. If the joint of the ankle or knee is involved, it is best to draw two closely fitting stockings upon the extremity. The cast should be worn for three or four months after the joint is apparently well. In the case of a hip-joint, enforced rest by fixation with a plaster-cast should be supplemented by the use of a weight-and-pulley extension to be applied at night for a period of at least two years after the joint has apparently fully recovered, for the reason that this plan of treatment tends to prevent recurrence. (Ochsner.)

This also tends to prevent deformity, to increase the comfort of the patients, and to remind them of the necessity of avoiding traumatism

for a considerable time. Extension is made by applying a strip of rubber adhesive plaster to the inner and outer surface of the entire thigh and leg, holding them in place by a roller bandage. These plaster strips are attached to the cord which passes over the pulley to the weight. The lower end of the bed should be elevated sufficiently to secure counter-extension from the weight of the body. The amount of weight to be employed may be determined best by the comfort of the patient.

Operation Upon the Joints.—After the diseased bone and tissue has been completely removed, the raw surfaces all should be thoroughly and repeatedly swabbed with a 95 percent solution of carbolic acid for a period of five minutes, then the superfluous acid should be washed away with strong alcohol. After this it is the custom of some surgeons to apply strong compound tincture of iodin to the entire surface, and, lastly, a 10 percent solution of iodoform and glycerin, after which the wound should be closed with deep sutures of catgut and superficial sutures of any desired material. If doubt exists as to the aseptic condition of the joint when the operation has been completed, the same should be freely drained with rubber tubes or with iodoform gauze passed transversely through the articulation. The joint is then covered with a large dressing and immobilized by means of splints or plaster-of-paris.

Treatment of Tuberculous Abscess of the Hip-joint.

English Method—Cheyne-Treves.—After free incision the abscess wall is clipped away, and by means of Barker's flushing spoon the abscess cavity thoroughly scraped and cleared out. The addition of flushing with hot normal salt solution to the use of a sharp spoon is a great safeguard against the risk of general infection which accompanies scraping alone. As the material is scraped away the rush of fluid through the instrument washes out the wound at once, and thus prevents infection being carried into the circulation. After the abscess has been scraped out, an ounce or more of 10 percent solution of iodoform and glycerin is injected into the cavity, the wound closed without drainage, and antiseptic dressings applied. The successful treatment depends upon strict asepsis. Should the wound become septic, good results cannot be expected from treatment of abscess alone. Should sepsis occur, serum may collect and the wound be distended, in which case, if there be fluctuation, the wound must be opened and the fluid evacuated. Effort should be made to heal the wound by granulation.

Should a sequestrum be felt when the abscess is opened and scraped,

or should a cheesy deposit in the bone be easily reached, it should be removed, but any further attempt to clear out the joint at this stage is unnecessary and should be avoided. (Cheyne-Burghard, "Manual of Surgical Treatment.")

When there are Septic Sinuses.—When septic sinuses are present, the conditions are altogether different, and in most cases excision is advisable. When the position of the limb is good and the patient's general health is satisfactory, and when there are only one or two sinuses, an attempt may be made, by proper fixation of the limb and the establishment of good drainage, to bring about a cure of the disease. All sinuses should be enlarged and their tracks thoroughly scraped, undiluted carbolic acid being applied to the whole length of each sinus before finishing the operation. When possible, if two or more sinuses can be made to communicate, a large drainage-tube should be passed through from one opening to the other, or the incision should be sufficiently free to include both, after which a large drainage-tube should be introduced, reaching down to the bone.

After-treatment of these cases will consist of complete fixation of the joint and careful dressing of the sinuses. The best method of fixing the joint is to apply a plaster-of-paris splint, in which suitable openings are left for dressing the sinuses; the plaster should extend up over the lower ribs. It should be strengthened both in front and behind the hip, either by strips of metal incorporated in the bandage or by strands of tow thoroughly impregnated with plaster. Below, it should reach to the upper part of the calf, so as to fix the knee-joint as well as the hip, and it should be applied with the limb in a position of abduction. When the sinuses are situated so that it is difficult to apply the bandage without covering them, metal bars bent outward opposite the wound may be incorporated with the bandage so as to provide a firm splint, and at the same time to give sufficient interruption in it to allow access to the wound.

The drainage-tubes should not be removed for at least a week, as otherwise there may be some difficulty in reintroducing them. When two sinuses have been made to communicate, and a tube has been passed from one to the other, a long loop of silk should be inserted into each end of the tube, and then, when it is desired to wash the latter, it will be easy to reintroduce it, because one end can be pulled upon until a considerable amount of the tube has been withdrawn; this portion can be washed with a 1:2000 sublimate solution, and, by traction upon the second loop, the other end of tube can be made to project, until the

whole tube has been thoroughly washed, when traction on the first loop will pull the tube into position again. After cleansing the tube it is well to dust it with iodoform before it is put back into position. We do not consider that these tubes should be syringed out with any antiseptic; the only result of this is to irritate the wound without doing any good. After about three weeks the tube may be cut in two and shortened, so that the outer end of each lies flush with the skin, while the deeper one goes to the bottom of the cavity. As healing takes place from the bottom, the tubes will be gradually pushed out and must be cut down. When a very large tube has been used at first, a somewhat smaller one may be substituted later.

When a tube has been passed into each of the sinuses they should not be disturbed for about a week. Each tube may then be withdrawn, cleaned, powdered with iodoform, and replaced. In all cases the tubes should be kept in as long as possible, and, when it is found that the large tube will not pass to the bottom of the sinus, one of smaller caliber must be substituted. It is well to substitute a fresh tube every few days, as granulation tissue grows through the holes and blocks the lumen. In the fresh tube the holes will be in a different position, and the difficulty is thus easily avoided.

In a certain number of cases, unfortunately few, the sinuses heal and the disease may be cured when the patient is under good hygienic conditions and carefully treated; but when there are a number of sinuses and when sepsis is marked, the attempt, as a rule, ends in failure, and it will be necessary to excise the joint. In other cases in which the disease is evidently active, and it is obvious that the patient cannot be placed under good hygienic conditions, it is well to excise the joint at once. Before proceeding to excision, the sinuses should be thoroughly scraped and sponged with pure carbolic acid, so as to render the wound as nearly aseptic as possible before the excision is performed.

Use of Carbolic Acid in Tuberculous Abscess.—Carbolic acid in dilute solutions was at one time injected into tuberculous cavities, but its use has been generally discontinued because of the danger of poisoning. Recently Phelps has advocated the use of pure carbolic acid in the treatment of tuberculous abscesses and sinuses. This is injected into the fistula or into the abscess cavity, which has been opened, and is allowed to remain for about a minute, when it is neutralized by copious injections of alcohol, after which the part is thoroughly cleansed by salt solution. Carbolic acid doubtless acts as a caustic, destroying the in-

fected granulations and stimulating the reparative processes. Other remedies of this class—for example, tincture of iodin, zinc chlorid, actual cautery, and the like—are also used, and in certain cases with benefit. In the treatment of tuberculous ulcerations ichthyol, balsam of Peru dissolved in castor oil of a strength of 10 percent, as suggested by Van Arsdale, is a satisfactory application.

Venous Stasis—Bier's Treatment.—Bier's treatment of tuberculous joint disease was suggested by the observation of Rokitanski, that phthisis was uncommon in individuals suffering from disease of the heart when the mechanical obstruction was sufficient to cause venous congestion of the lungs.

Treatment by means of venous stasis is conducted as follows: A rubber bandage is placed about the limb above the joint, under sufficient tension to interfere with the return of the venous blood; and in order to limit the congestion to the diseased part, the limb is firmly bandaged with a flannel bandage up to the joint, from below. Between the two the tissues about the joint become swollen, the local temperature is increased, and the color of the skin becomes bluish-red. At first the congestion is continued for short periods only during the day, as it is somewhat painful. These are lengthened, until finally it may be applied continuously.

If the disease is active, the treatment may hasten abscess formation; and if sinuses are present, the discharge is usually increased for a time. The venous congestion is supposed to stimulate the formation of healthy granulations and their further transformation into fibrous tissue; and according to the investigations of Hamburger, the serum of venous blood has a distinct germicidal property. The treatment may be applied most conveniently at the knee-joint and ankle-joint, but if applied, it should serve merely as an adjunct to mechanical protection.

Iodoform-glycerin Injections of Tuberculous Joints.—A 10 percent solution of iodoform in glycerin has been very much extolled in the treatment of tuberculous joints. Ochsner lays down several points in the technic which should be carefully obeyed:

"1. The trocar should never be plunged directly into a joint, but always obliquely underneath a fold of skin, so that a valve will be formed when the trocar is withdrawn, which will prevent infection of the joint-cavity with pathogenic microorganisms.

"2. The amount of pressure employed in injecting the solution should be moderate in order to avoid rupturing the capsule of the joint and

forcing the fluid, together with tuberculous contents of the joint, into the tissues surrounding.

"3. The amount of manipulation should be limited, in order to prevent the opening of lymph-spaces through which secondary infection might occur.

"4. If the treatment does not result in distinct benefit to the patient after five or six applications from one to two weeks apart, it should be abandoned.

"5. The patient's general and hygienic influences must be improved.

"6. As much as possible of the fluid contained in the joint should be withdrawn before the injection is made.

"7. Except in the shoulder and in the sacroiliac joints, an Esmarch constrictor should be applied before the joint is tapped, and left in place until a large dressing has been fitted and held in position by a snug bandage, which will prevent hemorrhage into the joint.

"This last precaution is not generally employed, but I am confident that it is of distinct benefit.

"In inserting the trocar into the various joints, aside from carefully securing a valve formation of the canal, the surgeon must avoid injuring important anatomic structures in the vicinity of the joint, and the point of the trocar must be directed so that it will not injure any joint surface.

"In the smaller joints a very small amount of the solution may suffice, the quantity employed depending upon the tension caused by the fluid injected, which should never be sufficiently great to endanger the capsule or to produce severe pain. In the wrist-joint the introduction of the fine trocar used is usually not followed by the evacuation of any fluid, and here the injection of 2 to 4 c.c. will often be followed by good results. In the knee-joint it is often possible to withdraw several ounces of fluid, and in cases it is safe to inject as high as 30 or 40 c.c. of the iodoform-glycerin solution.

"In order to prevent too great tension in injecting this solution into tuberculous joints, it is well to attach a soft-rubber tube to the trocar with one end, and to a glass syringe holding 20 c.c. with the other, and then to pour the solution into the glass syringe and to introduce the plunger after the rubber tube and the trocar have become filled with the solution spontaneously. In forcing in the plunger, if the pressure becomes too great, the intervening rubber tube will become dilated before a sufficient amount of pressure has been exerted to injure the capsule of the joint. In injecting the large joints a large trocar is

used, but in the smaller joints the trocar should be just large enough to permit the transmission of the iodoform." (Ochsner's "Surgery.")

After-treatment.—Until the pain has subsided the patient should be kept at rest; then a moderate amount of exercise is useful. The injection is repeated every one to two weeks at first, and less frequently later.

Whitman's Methods of Treatment,* etc.—Tuberculous abscess is a symptom and common accompaniment of hip disease, which, in cases treated under proper conditions, is not of great importance; and yet, on the other hand, it is recognized as a dangerous complication. It is dangerous to life because of the profuse suppuration that may follow infection, and to function because of the adhesions and contractions that may result.

The Significance of Abscess.—If abscess appears early in the course of the disease, it usually indicates that it is of a destructive character and that the interior of the joint is involved, therefore perfect function is less likely to be preserved than in those cases in which the disease has been confined to the interior of the bone.

In certain instances abscess formation is preceded by an acute exacerbation of symptoms, by pain, by an increase of muscular spasm and consequent distortion, and often by an elevation of temperature. These acute symptoms subside and a fluctuating swelling appears. It may be inferred that the pain in such a case was due to the tension of the abscess within the capsule, and that the relief of pain followed perforation and the escape of the fluid.

Treatment.—Some surgeons have advocated absolute noninterference with the symptomatic abscess on the ground that in many instances it finally disappears by spontaneous absorption; while in other cases the long delay allows the communication with the joint to close, so that the danger of infection after an opening has formed is slight. Finally, that the results after noninterference are better than those reported after operative treatment. Others insist that all collections of fluid of this character should be evacuated when they are discovered, because of the danger of infection before an opening forms and because of the advantage gained by preventing burrowing of pus. There would be little to be said against this latter course were it not that infection is as common after operative treatment as when a spontaneous opening forms; the only advantage in favor of the artificial opening being that the cavity with which it communicates should be smaller than when the incision has

* "Orthopædic Surgery," Whitman. Lea Brothers & Co.

been long delayed; but this is offset by the fact that at least 20 percent of abscesses disappear without treatment. In fact, as compared with indiscriminate incisions, when proper precaution and care cannot be assured, the let-alone treatment should be preferred.

It would appear, however, that the middle course—between the extremes—is the safest, and especially so as by far the larger number of patients must be treated under conditions which do not admit of proper care. In the outdoor department of the New York Hospital for Ruptured and Crippled abscesses are treated symptomatically. If a swelling appears but remains quiescent and causes no symptoms, it is not disturbed. If it enlarges, the tension of the fluid is relieved by aspiration, which may be repeated as required, compression, after the evacuation of the fluid, being applied by a pad and bandage. If the abscess is on the point of finding a spontaneous opening, or if its contents are of such a nature that aspiration is impossible, an incision is made and the proper dressings are applied; or, if the child lives at a distance from the hospital, the mother is instructed in the manner of dressing and as to the importance of cleanliness. If the abscess is of large size, or if acute symptoms are present, the child is admitted to the hospital. Here the same general principle is followed, but at the present time the routine of treatment of noninfected abscess is free incision, that will allow complete evacuation of its contents. The abscess membrane is removed by gently rubbing with iodoformized gauze.

If the opening in the capsule of the joint is exposed, this may be enlarged to permit evacuation of the products of disease within the joint; the wound is then closed with superficial and deep sutures and a firm dressing applied. This operation, if performed under aseptic precautions, causes no disturbance, and it removes necrotic material which must be an obstacle to spontaneous absorption. In many instances the abscess is permanently cured, although if the condition that induced the abscess remains unchanged, fluid will again accumulate, and if so a spontaneous opening will form at the site of the operation. This operation is not a radical cure of the abscess or of the disease; it is simply a means of thorough evacuation for the purpose of accomplishing what the aspirator does only in part. If the abscess has become infected, its contents are completely removed; the wound is then packed with gauze and provision is made for efficient drainage.

In the treatment of abscesses the injection of iodoform emulsion, in connection with the aspiration, has been thoroughly tested. The

results, so far as the disappearance of the abscess is concerned, are not as good as from simple aspiration; and as the procedure, being somewhat of the nature of an operation, causes the patients some discomfort and anxiety, it has been discontinued in the practice of the surgeons here quoted. From the clinical standpoint there is little evidence that these injections exercise any particular influence upon the disease, but theoretically iodoform should lessen the infectiousness of the tuberculous fluid, and there appears to be no serious objection to its use.

The most important element in the postoperative treatment of abscesses of the hip is the prevention of contraction and subsequent deformity of the limb, as well as the correction of or reduction of the deformity in neglected or resistant cases. In nearly all large abscesses of the hip more or less structural changes and shortening of the muscles and contracture of the surrounding tissues are necessary concomitants of the disease. Fibrous tissues may form with contraction of the muscles to such an extent as to destroy the functions of the limb. The head of the femur, or what is left of it, may be dislocated, and the limb be fixed in such a position as to require forcible reduction under anesthesia, or osteotomy may be necessary. It should be remembered that deformity is not actually the result of a disease, but rather negligence on the part of the surgeon who fails to recognize the importance of prevention. After the reduction of the deformity, regardless of the method employed, the limb should be fixed in a long spica bandage and held in this position by this or other fixed appliances until the tendency to deformity has been overcome.

The Relative Efficiency of Traction and Splinting.—Fixation.—In considering the vexed question of the relative merits of splinting and traction in preventing subsequent deformity, muscular spasm, and the consequent intra-articular pressure which causes pain and increases the destructive effects of the disease, these facts must be borne in mind.

When the patient is fixed in the recumbent posture it is possible to apply sufficient traction upon the muscles to prevent the contraction that causes injurious pressure, and although no amount of traction will absolutely prevent motion, yet with the support that the bed provides, practically speaking, complete rest may be assured. Only in the exceptional cases in which the tension upon congested tissues about an acutely inflamed joint is intolerable is this method of treatment inefficient.

The same statement is true of a properly applied spica bandage or Thomas brace, when the patient is recumbent, that it assures practical rest; thus it prevents muscular contraction, relieves the symptoms, and promotes repair, although it cannot be claimed that the surfaces of the opposing bones are actually separated from one another.

But what is true when the patient is recumbent is not true of ambulatory treatment. The traction exerted by the hip splint even when the limb is pendant is far less effective than in recumbency, and when it is used as a walking appliance, for which it was designed and for which it is practically always employed, the traction is intermittent and of doubtful efficiency. The same loss in efficiency in less degree occurs in all forms of fixative apparatus when used in ambulation.

The Removal of Direct Pressure.—"Stilting."—Granting that the traction brace as a walking appliance is relatively inefficient in preventing motion, and that motion without friction, provided the joint surfaces are actually involved, is impossible, still it cannot be denied that the traction brace is, or may be, at all times an effective stilt in that it protects the joint from concussion and pressure by removing the foot from contact with the ground, and prevents displacements or deformity.

It is true that the removal of direct pressure may be attained by the use of axillary crutches, but in Thomas' practice they were used in but few cases. In fact, it is only by constant supervision that the use of crutches can be enforced upon children who no longer suffer pain, and as it is practically impossible to prevent the patient from bearing weight upon the limb, stilting by this means is relatively inefficient.

That direct pressure is one of the causes of upward displacement of the femur may be inferred from the statistics of Sasse and Bruns, from the surgical clinics of Berlin and Tübingen, where the routine of treatment is the plaster bandage, without the high shoe or crutches. In two-thirds of Sasse's and in four-fifths of Bruns' cases there was upward displacement of the trochanter. This is certainly a larger proportion than would be found in a corresponding number of patients treated by efficient stilting, although statistics on this point from American sources are lacking.

In the final comparison of the claims of traction and fixation it is of interest to note that the most enthusiastic advocate of the Thomas treatment in this country was trained in the use of the traction hip brace at the New York Orthopædic and Dispensary Hospital, an in-

stitution founded by Taylor and in which his methods have been closely followed. Ridlon states that an experience in the treatment of 1100 cases by the traction hip splint led him to discard it in favor of the Thomas brace.

The Practical Combination of Traction Splinting and Stilting.—Thus far, the methods of treatment by splinting and traction have been presented as if they were necessarily opposed to one another in principle, and as if the theory were still held that motion without friction is possible; and as if it were believed that ankylosis is caused by fixation and is prevented by the motion of a diseased joint. At the present time, however, it is generally recognized that the principle involved in both methods is the same and that the actual merit

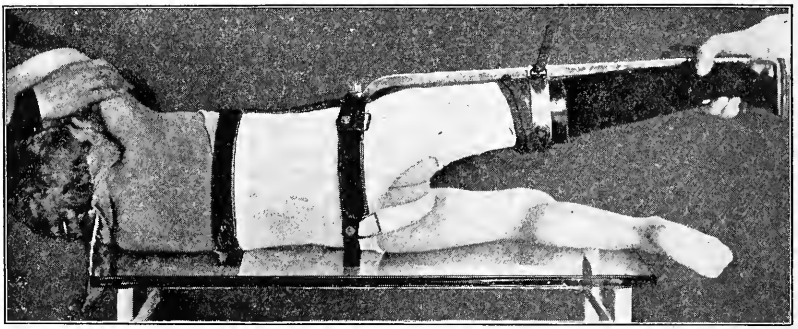

Fig. 80.—The Short Spica Bandage in Combination with the Brace. One Perineal Band has been Removed in Order to show How the Joint is Supported by the Bandage.—(*Whitman.*)

of each must be decided by practical experience rather than by argument. The true test of the relative value of a routine treatment is its efficacy in hospital practice, where its weak points cannot be supplemented by the careful supervision that may make effective almost any treatment that carries out in some degree the proper principle. This test is all the more necessary because the great majority of cases of this character are to be found among the poor.

A combination of the Thomas brace and the traction hip splint (see Fig. 80) is the most effective mechanical means of relieving pain and preventing deformity that can be employed in ambulatory treatment. It has, however, the disadvantage of requiring careful adjustment, and it obliges the patient to wear shoulder straps; in other words, much care must be exercised to insure the comfortable adjust-

ment of both appliances. Thus the next step was the combination of the two, even though the action was somewhat less effective. To the pelvic band of the traction brace a lateral thoracic bar was attached reaching upward in the axillary line to a point opposite the middle of the scapula, where it was joined to a metal band that encircled the chest, like that of the Phelps brace. When this was securely fastened about the chest, the body and the limb were held in line by a long lateral brace; the pelvis was supported by the pelvic band and the joint received the additional protection that was assured by traction and stilting (Figs. 81 and 82).

This brace and another form similar in principle, in which the upright of the thoracic attachment is fixed posteriorly to the pelvic band, are now in general use at the New York Hospital for Ruptured and Crippled. The efficiency of this brace may be still further increased by replacing the perineal bands by a metallic ring. This ring, which fits the upper extremity of the thigh closely, is attached to the upright at an inclination corresponding to the line of the groin.

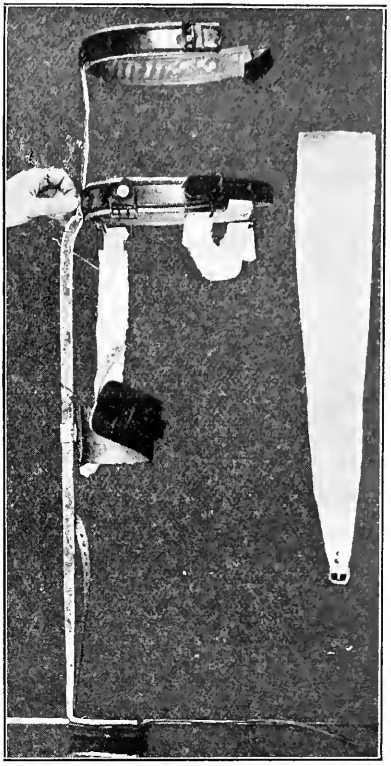

FIG. 81. — THE LONG INEXPENSIVE BRACE WITH SOLID UPRIGHT SHOWING THE PERINEAL BANDS AND THE ADHESIVE PLASTER, AS USED IN HOSPITAL PRACTICE.—(*Whitman.*)

It is a better support because it prevents anteroposterior motion within the pelvic band, which the perineal straps allow. The ring may be used as the only support or it may be combined with a perineal band on the opposite side. This is of advantage if there is a tendency toward adduction.

The apparatus is most satisfactory when the hollow upright of the Taylor brace is used. This is light and strong and is provided with an arrangement for effective traction, but in hospital practice the upright is made of solid metal, and the traction is adjusted by simple

straps. The metallic ring, besides providing better fixation, is a firm support that cannot be disturbed by the patient. It is, of course, more difficult of adjustment, and it is not suited to the treatment of young children because of the difficulty in keeping it clean and dry.

The Thomas ring was first applied to a hip splint by Phelps (Fig. 82), who has always urged the advantages of fixation and traction, and his brace, of which that last described is simply a slight modification, is supplied with an arrangement for lateral traction. Practically speaking, this is a tape by which the lower third of the thigh is held in apposition to the upright. It hardly seems possible that appreciable lateral traction can be exerted on the joint by this means, and certainly none whatever if the metallic ring is properly fitted to the thigh. The simple straps do not afford as effective traction as the rack and pinion, nor is the brace, as usually constructed, sufficiently

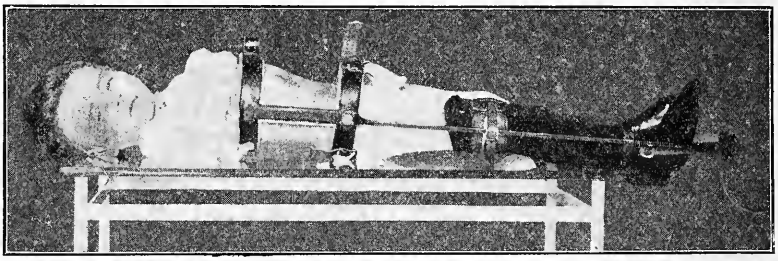

FIG. 82.—THE LONG HIP SPLINT APPLIED.—(*Whitman.*)

strong to bear the weight of the body without bending. It should be stated, however, that this form of brace is intended to be used with crutches rather than as a walking appliance.

Many objections to this attempt to combine the two methods of treatment in one appliance have been urged by those who believe in the efficiency of the traction brace. For example, it is said that the splinting is ineffective because the movements of the trunk are transmitted to the joint, while this is not true of braces that do not extend above the pelvis. In reply, it may be stated that the traction part of the combined splint remains as effective as before; thus it follows that this suggestion is an acknowledgment of the fact that the theory of motion without friction is no longer tenable. As a matter of fact, however, it will be found that motion of the upper part of the trunk is absorbed, as it were, in the flexible lumbar region of the spine, before

it reaches the joint. If, however, such motion or any motion causes discomfort or aggravates the symptoms, the patient should be confined in the recumbent posture until the acute phase of the disease is passed.

It is said that the brace is cumbersome, that the patient cannot

FIG. 83.—THE LONG BRACE WITH THOMAS RING AND EXTENSION UPRIGHT, SIMILAR TO PHELPS BRACE.—(*Whitman.*)

FIG. 84.—REAR VIEW OF BRACE.—(*Whitman.*)

sit with comfort, and that it prevents normal activity. A long brace certainly weighs more than a short one, and if a brace prevents flexion at the hip and spine, it is evident that the patient cannot sit with com-

fort in an ordinary chair. As a matter of fact, the patients themselves make little complaint of the brace, even when it has been substituted for an ordinary traction splint; while the greater restraint of activity is a favorable element of treatment, since children who do not suffer pain are much more likely to be too active than to be restrained by any form of appliance. These objections are trivial, if one is convinced that the dangerous and deforming disease that is under treat-

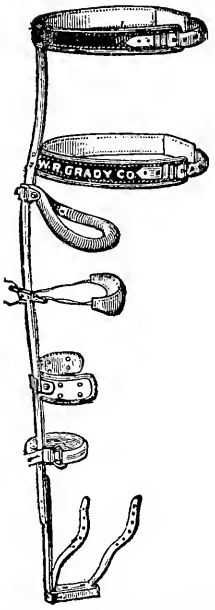

FIG. 85.—PHELPS HIP SPLINT.

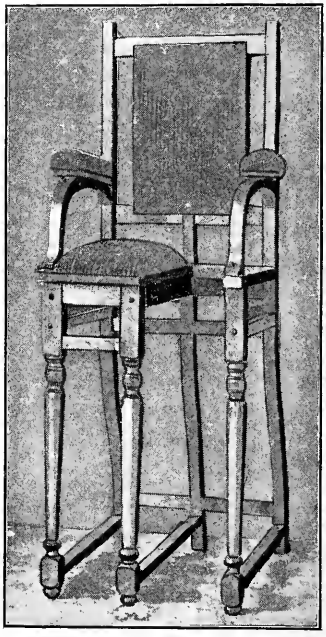

FIG. 86.—A CHAIR TO BE USED WITH THE LONG HIP SPLINT.

The patient sits upon the sound side, while the splinted half of the body remains in the extended position, the brace resting on the floor.—(*Whitman.*)

ment may be more easily controlled and that the final result is likely to be better and to be more rapidly attained by this means than by another.

This form of brace is used exactly as in the ordinary traction brace. If deformity be present, it is reduced by one or another of the methods that have been described. If the disease be acute, recumbency and traction are employed until this stage is passed. When ambulation

is resumed, crutches may be employed for a time, but during the greater part of the treatment the brace is used as a walking appliance; as accurate splinting and as effective traction being employed during this period as circumstance will permit. During the entire course of treatment, supervision of the patient, with the aim of adapting his activity to the local weakness, should be exercised, even though it may be less essential than when other apparatus is employed.

CHAPTER XV.

MODERN TREATMENT OF COMPOUND FRACTURES.

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Methods Advocated by Nicholas Senn.—The modern antiseptic treatment must vary according to the nature of the wound and the manner in which it was inflicted. As a general rule, it may be stated that the first dressing decides the fate of the patient, and determines the process of wound healing. The treatment of the wound is of far greater consequence than that of the fracture itself, more especially during the first two weeks. A combination of most thorough antiseptic treatment of the former, immediate and perfect reduction of the latter, followed by fixation of the fractured limb by some kind of plastic splint, yields the best results. Whenever there is any prospect of obtaining primary healing of the wound, the attempt should be most faithfully made. In punctured and gunshot fractures and when the wound is small and clean-cut, the surrounding skin for a distance of several inches should be shaved and thoroughly disinfected by scrubbing with hot water and potash soap, then with alcohol, and lastly with a 5 percent carbolic acid or a 1:1000 mercuric chlorid solution. If the bone projects from the wound, the part protruding should be included in the disinfection before reduction is made, as otherwise infection may be caused by the reduction. Such fractures must never be explored, and the wound should not be enlarged unless reduction is impossible without so doing or complications present themselves that demand it. Resection of the projecting fragment is seldom necessary, as reduction can usually be effected under the influence of an anesthetic. It is in cases of this kind and in gunshot fractures that, as a rule, the wound beneath the skin is aseptic. Suturing of such wounds should be avoided.

The wound, properly disinfected, is dressed by applying an antiseptic occlusion dressing. For this purpose nothing is more efficient than a nonirritating effective antiseptic powder, composed of four parts of boric acid to one part of salicylic acid, and a compress of aseptic absorbent cotton. Cotton is preferable to gauze, as it serves as a more efficient filter, and with the powder and blood is soon converted

into a dry crust that seals the wound hermetically and excludes it from the entrance of pathogenic microbes. About a teaspoonful of the borosalicylic powder is placed on the wound, and the cotton compress is applied and retained with a gauze roller, or, if there is any danger of it becoming displaced, it is fastened in place with a strip of adhesive plaster before the bandage is applied. The dressing should not be disturbed until the wound is healed, unless signs and symptoms indicate the existence of infection. Should infection follow this treatment, removal of the dressing, enlargement of the wound, counter-openings, efficient tubular drainage, energetic secondary disinfection, and substitution of the hot antiseptic compress for the dry dressing is the proper course to pursue. If wound infection does not occur, the compound fracture is practically converted at once into a simple subcutaneous fracture, and should be treated as such.

P. Bruns recommends for similar cases a powder composed of—

Carbolic acid,	25 parts.
Colophonium,	60 "
Stearin,	13 "
Precipitated carbonate of lime,	700 "

Senn further says: "I have, however, used the borosalicylic powder, in the proportion specified, on an extensive scale, both in civil and military practice, and have been so much gratified with the results that I can recommend it most emphatically as a local application in such cases, used in the manner described.

"In LACERATED AND CONTUSED WOUNDS the first and most important duty in rendering first aid is to subject the wound to an absolutely efficient and safe primary disinfection. This can be done only by first shaving and disinfecting the part of the limb that is the seat of the fracture, and, if the fracture is near a joint, as much of the adjacent part of the limb or trunk as will be covered by the large antiseptic dressing. A common error made in the management of such cases is that the surface disinfection is not extended far enough. If the wound disinfection cannot be made with sufficient thoroughness without the use of an anesthetic, it is preferable to anesthetize the patient rather than neglect meeting, to the fullest extent, the most important indications in the treatment of the wound. All such wounds must be regarded and treated as infected wounds. In most instances the wound is larger underneath the skin than on the surface, and a thorough primary disinfection is out of question without enlarging the exter-

nal wound sufficiently to expose every nook and corner for the direct application of the antiseptic solution. After free exposure of the wound surface the surgeon removes blood-clots, foreign bodies, and loose fragments not required in a satisfactory process of repair. If on hand, hydrogen dioxid should now be poured into the wound; if not, antiseptic irrigation with a hot 2.5 percent carbolic acid solution or a solution of mercuric chlorid, 1 : 1000, should at once be commenced and continued until the wound is surgically clean. I have more faith in carbolic acid than in mercuric chlorid as a disinfecting agent in the treatment of accidental wounds, as it penetrates the tissues more deeply and leaves them in a more favorable condition for the healing of the wound by primary intention. In extensive lacerated wounds it is advisable to cut away the torn margins, converting the wound as nearly as possible into an incised wound, better adapted for successful suturing. The deeper portions of the wound can be treated in the same manner if they are covered with torn tissue that would be in the way of primary union, for the purpose of preparing the surfaces for buried sutures, which can often be employed to advantage in diminishing the size of the wound and the space requiring drainage. The buried suture, of aseptic catgut, is of special value in suturing vascular tissue over the detached fragments if the fracture is a comminuted one. The disinfection must extend to the seat of fracture. All the loose fragments should be removed, disinfected in the carbolic acid solution, and immersed in a warm saline solution, ready for reimplantation after the wound has been disinfected.

"COUNTEROPENINGS FOR DRAINAGE may become necessary if the wound is irregular, and dead spaces cannot be avoided by buried sutures. Tubular drains well fenestrated must be employed for this purpose. The counteropenings are made by tunneling the soft tissues from the side of the wound with a pair of locked hemostatic forceps, which are pushed in the desired direction until the skin over the point of the instrument is raised in the form of a cone, which is then incised at its base on one side, and the instrument made to emerge from the wound; the drain is grasped and brought into the wound with the return of the forceps. The tube should not project further into the wound than the cavity it is intended to drain. In large wounds multiple counteropenings may become necessary. For this special purpose the drains should never be thinner than the little finger, and should not be disturbed until the time for infection to take place has elapsed—

that is, for from forty-eight to seventy-two hours. The wound itself must never be entirely closed by suturing, as drainage is always required in such cases, and must be maintained until all danger from infection has passed. The wound is drained, in preference, with a single strip of iodoform gauze, the projecting end of which is secured by a large, aseptic safety-pin. Two ways present themselves for dressing the wound: (1) with the dry dressing; (2) with the moist dressing. The surgeon must discriminate carefully in making the selection. The typical dry absorbent antiseptic gauze dressing is indicated in wounds that, from their size, from the time that has elapsed from the receipt of the injury to the first dressing, and from the thoroughness with which the primary disinfection was made, we have reason to expect will heal by primary intention. In applying such a dressing a few layers of iodoform gauze should be placed next to the wound, the bulk of the dressing being made of sterile gauze, and over and around it a thick cushion of absorbent cotton should be placed. The dressing should be a copious one, and should be retained in place by a gauze roller. So copious a dressing exerts an equable elastic pressure, so important an element in securing muscular rest and in holding in accurate and uninterrupted contact the wound surfaces. After the dressing has been applied and the fractured bone placed in proper position, a fixation splint of some kind should be applied over the wound dressing. In case no infection sets in, the first dressing may remain in place for two or three weeks. Should the dressing become saturated with blood, the surface may be sprinkled with borosalicylic powder, and an additional layer of cotton be applied, to make an early change of dressing unnecessary. Nothing is more harmful in the treatment of a compound fracture than meddlesome surgery; the longer a dressing can remain with impunity, the greater is the probability of avoiding infection, and the better are the chances of obtaining primary healing of the wound."

The after-treatment of a compound fracture by the surgeon cannot be too carefully watched. He must, day after day, look for evidences of infection. A rise in temperature during the first twenty-four hours usually means ferment intoxication; after that time it suggests septic infection. In fermentation fever the subjective symptoms are generally *nil;* in sepsis they correspond in intensity with the degree of intoxication. The condition of the tongue is of more diagnostic importance than the character and frequency of the pulse in

discriminating between fever and sepsis. In septicæmia the tongue is dry and usually brown; in fermentation fever it is moist and coated. If, from the local and general symptoms, it becomes apparent that the wound has become infected, no time must be lost in removing the dressing and in making additional provision for drainage. Secondary disinfection is generally incomplete and unsatisfactory. If the wound has been sutured, every stitch must be removed and drainage established wherever it appears necessary. The moist antiseptic compress must invariably take the place of the dry dressing, and frequent antiseptic flushings become indispensable. It is advisable, under such circumstances, to replace the more energetic antiseptic solutions, such as carbolic acid and mercuric chlorid, by Thiersch's solution or a saturated solution of the acetate of aluminium, as the former, used in large quantities and at short intervals, might, and often do, result in intoxication that may prove disastrous and even fatal.

The ANTISEPTIC IRRIGATION should be preceded by the injection of hydrogen dioxid. If suppuration does not yield promptly to this treatment, continuous irrigation with either of the mild antiseptic solutions must be instituted at once, and has often, in my experience, been the means of averting death from sepsis and in preventing the necessity of a secondary amputation. Should this treatment not make a prompt impression by improving the local conditions and by ameliorating the general symptoms, the propriety of performing a secondary amputation must be considered, with a view to preventing death from septicopyemia.

CONTINUOUS IRRIGATION by means of the thermal irrigator as described in Fig. 87 should be used, or in the absence of this apparatus a simple yet effective irrigator may be arranged in the following manner: A piece of rubber tubing, six or eight feet in length, can be used as a siphon, or may be connected with an opening on one side near the bottom of the reservoir holding the antiseptic solution, and with one of the drains in the wound. A stop-cock or clothes-pin is used to regulate the size and force of the stream. The solution must be kept at a temperature of blood-heat, or, still better, a little higher, and if more than one drain is employed, the point of irrigation is changed at certain intervals from one to the other. If many drains have been used, it is advisable to connect them with several siphon tubes so as to flush the different parts of the wound continuously. By suspending the limb, properly immobilized, and placing underneath it a rubber sheet,

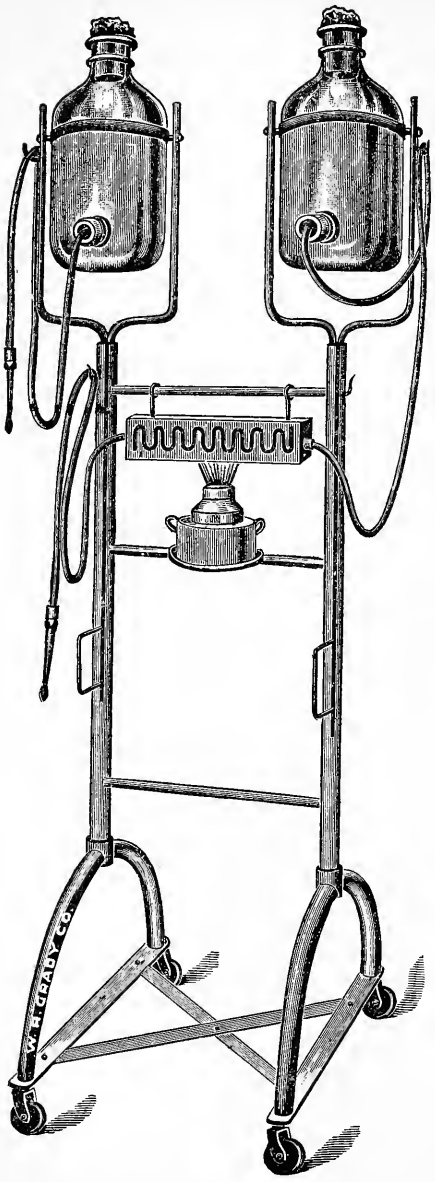

FIG. 87.—THERMAL IRRIGATOR STAND.

This furnishes means for irrigating with warm solutions, without the necessity of filling the bottles with hot fluids. The outfit consists of two irrigating bottles, mounted on a strong upright frame, supplied with heavy, rubber-covered casters. The bottles are adjustable to various heights as required. A tank with lamp is provided, the former containing a coil of sufficient length to allow fluid passing through it to become heated to the proper temperature. With a Volkmann dropping-tube for continuous wound irrigation, it makes an ideal irrigator.

the fluid is drained into a vessel by the side of the bed. A compress saturated with the same solution is made to cover the wound and is to be changed several times a day. The general treatment in such cases must be stimulating and tonic, supported by a concentrated and nutritious diet. Should an adjacent joint become involved, free drainage and continuous irrigation constitute the proper local treatment. Progressive phlegmonous inflammation calls for free drainage and frequent or continuous irrigation.

It is in cases of this kind that signal benefit has been derived from applying a compress saturated with a 1 : 1000 solution of either the lactate or the citrate of silver. If a secondary amputation becomes necessary, the operation must be performed through healthy tissue, at a safe distance from the infected territory.

Comminuted Compound Fracture of the Skull.—The mistake is frequently made of not removing a sufficient amount of the fractured bone. Spicules left even where the periosteum is adherent frequently inflame and cause a thickness or callus which may later cause pressure at the seat of the fracture. Every step of the procedure must be done under strict aseptic precautions. Before the wound is touched the whole scalp, or a large portion at least, should be carefully shaved and the surface of the wound thoroughly disinfected. The trephine is rarely needed. Senn recommends that all loose fragments removed should be placed in a warm 2.5 percent solution of carbolic acid for disinfection, reimplanting them carefully after the wound disinfection has been completed. Depressed fragments are elevated with the utmost care to preserve their vascular connection, and if the brain has been exposed or injured, subdural drainage is always necessary.

After the wound has been rendered surgically clean, if it is thought best to replace the loose fragments, they are transferred from the carbolized solution into a warm solution of salt, prior to their being placed upon the surface of the dura. If the fragments are large, Senn considers it advisable to fragment them with bone forceps, and reduce them to the size of the thumb-nail or smaller. The fragments are then conveyed from the salt solution to the surface of the dura with dissecting forceps, and are planted in such a manner that the smooth surface comes in contact with the dura. After placing them in position, the pericranium and skin are sutured over so as to secure for the bone-chips vascular tissue on both sides. Drainage is established through a counteropening in the scalp some distance from the fracture.

Dry iodoform gauze dressings are applied and held in place by a roller bandage. If the wound remains aseptic, the fragments will recover their vitality, and the continuity of the skull will be restored. Should the wound become infected, all the sutures must be removed, the wound opened wider, and all the loose fragments removed. Another attempt may be made to render them aseptic by resorting to a vigorous secondary disinfection with hydrogen peroxid, 2.5 percent carbolic acid solution, or a 1 percent solution of formalin.

Open treatment and the substitution of warm antiseptic moist compresses in place of dry dressings constitute the appropriate after-treatment.

Compound Fractures of the Leg.—After thorough disinfection of the wound and limb and proper fixation of the bones, the limb

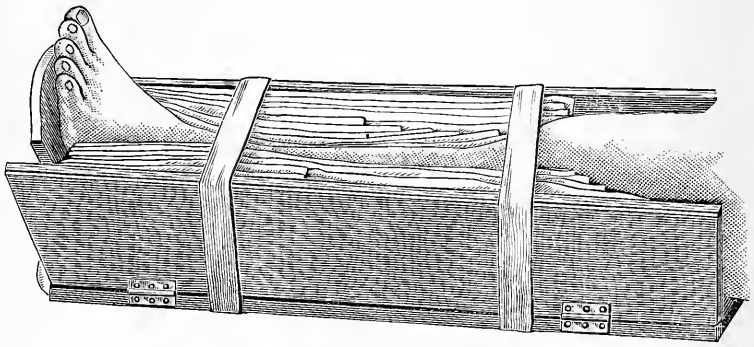

FIG. 88.—FRACTURE BOX.—(*Brewer.*)

must be placed in a suitable splint in order to secure immobilization and prevent displacement of the fragments, even when attempts at direct fixation have been made. Tenotomy is often necessary and frequently aids materially in the after-treatment of the more serious cases. Regarding this procedure, Dennis writes as follows: "Several years ago the author called attention to tenotomy in the treatment of compound fractures, and in a number of cases since then he has been impressed with the value of the operation in all oblique compound fractures, as well as in many simple fractures. Tenotomy relieves at once any contraction of the muscles, permits the fragments to be placed in accurate coaptation, and secures physiologic rest to the fracture. It affords also great comfort to the patient, and is a valuable means of fixation during the first ten days. Tenotomy may be employed upon the tendo Achillis, upon the hamstring muscles, upon

the tendons of the arm and forearm, and even upon the sternomastoid muscle in fractures of the clavicle."

The swelling following a compound fracture is usually far more extensive than after simple fractures, hence it is frequently a matter of great importance to adjust a splint or external fixation dressing that will make allowance for subsequent swelling, and that need not be removed or disturbed in order to inspect or redress the wound. In fractures of the leg the author still employs the "fracture box of our fathers" as being the safest and most comfortable temporary splint that can be used.

For compound fractures of the thigh a modified Buck's extension apparatus answers every purpose, and later, when all acute symptoms have subsided, a plaster-of-paris splint (von Esmarch) may be safely applied.

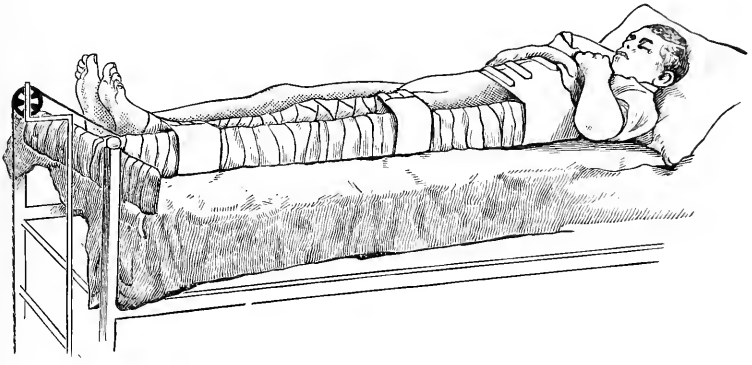

FIG. 89.—MODIFIED BUCK'S EXTENSION APPARATUS.—(*Brewer.*)

The patient must be placed in a narrow bed with a firm hard mattress. Later, there is frequently a tendency to eversion of the foot. This may be corrected by pinning a strip of canton flannel along the inner side of the leg bandage, passing it under the leg and over the side-splint, where it is secured by several tacks. This suspends the leg, taking pressure from the heel, and causes the required inversion (Fig. 90).

IMMOBILIZATION OF FRACTURE, by means of sutures, wire, ivory pins, nails, bone ferrules, screws, etc., cannot be relied upon exclusively. A suitable external splint is therefore needed. In applying any splint or retention device, the soft parts should be protected, especially near and over the seat of injury, and in the neighborhood of the bony promi-

nences, by cotton pads, or preferably sheet-wadding. Care should be taken to avoid undue pressure, and a portion of the limb below the seat of the injury should always be left exposed to enable the surgeon to watch the condition of the circulation. In all cases in which extensive contusions, edema, or ecchymoses exist, the dressings should be removed and the parts inspected frequently until all danger of strangulation, sloughing, or gangrene has passed.

In all compound fractures, when the swelling and inflammation have in a great measure disappeared, the limb should be placed in a more fixed or permanent dressing. The fenestrated plaster cast or wire splint, allowing free access to the wound and drainage openings, will be found most useful and hasten resolution by enforcing rest.

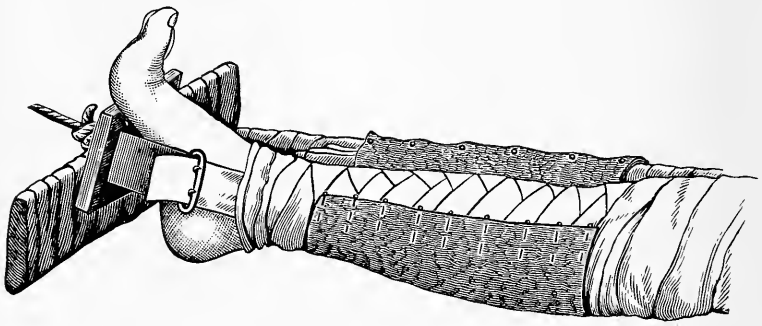

Fig. 90.—Appliance to Overcome Eversion.—(*Brewer.*)

To apply an encircling plaster cast to a member, the limb should be held firmly in position by assistants. A thin layer of lint or lintine should first be evenly applied to the part, after which several layers of sheet-wadding should be placed carefully around the limb. This is more easily applied if made into rollers. After the limb is evenly covered by this material, several rollers of crinolin impregnated with plaster-of-paris should be placed in warm water to which a teaspoonful of salt has been added. A plaster roller should then be applied to the limb, covering the parts evenly with from four to six layers of the plaster-holding material. Where a light cast is desirable, thin strips of splint-wood may be inserted between the layers and less plaster applied. (Brewer.)

A window should be left or subsequently cut in the plaster, freely exposing the wounded area, which can then be dressed without removing the supporting cast (Fig. 91).

The cast is usually allowed to remain from five to seven weeks, at which time it should be removed and the limb carefully inspected. If at this time the external wound is entirely healed and the fracture shows evidence of union, an ambulatory splint may now be adjusted, which will admit of greater freedom and be more comfortable to the patient.

Massage of the entire limb should now be employed, and later passive motion of the knee-joint and ankle-joint should occasionally be made until recovery is complete.

After-care of Compound Fracture of the Arm at or near the Elbow.—The treatment of compound fracture of the arm is practically the same as compound fracture occurring at any other point, so far as the fixation or adjustment of the bones is concerned, but where injuries

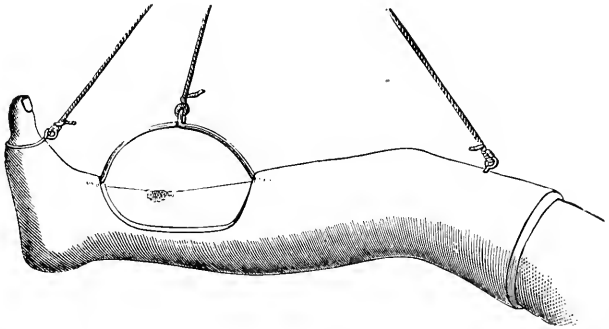

Fig. 91.—Plaster Cast with Wound Exposed.—(*Stimson.*)

occur near the elbow, the reapplying of splints and apparatus should be done sufficiently often to discover undue swelling or pressure upon the arm. All apparatus should be removed at least once a week and carefully inspected during this interval. In most instances it will be wise to delay passive motion until firm union of the bones takes place, seldom before the sixth to the eighth week, and even then must be very gently performed. Massage to the hand, wrist, forearm, elbow, and upper arm after the external wound has healed and the swelling has begun to subside, is of great value. The removal of the splint should be tentative and gradual after the union is known to be firm. (Scudder.)

The arm should be held in a sling for an hour and then the splint applied. The following day a longer interval is granted without the splint, and gradually the splint is removed entirely.

A snugly fitting bandage will often prove comfortable as a support on first leaving off the splint. Passive motion, massage, and active use

of the arm will now assist in regaining the use of the joint. At this stage the carrying of dumb-bells, pails or baskets filled with sand, and the doing of certain gymnastic movements with the injured arm will be of material aid. All violent exercise of the part is to be avoided. That amount of exercise may be allowed which leaves the arm moderately tired.

These patients should be kept under observation for at least four months. It is wise to treat such cases until all that can be achieved toward a restoration of function has been accomplished. (Scudder.)

After-treatment and Progress of Fracture of the Thigh.—Inspection of the fractured limb should be made at least daily. Measurement should be made twice a week during the first few weeks, the internal malleolus being reached through the bandage. Parts of the apparatus may need changing, and straps may require tightening or loosening. The heel and sacrum will require attention because of the constant pressure from lying in one position.

Ordinarily, there will be little or no pain associated with the repair of the fracture. After about four weeks all apparatus should be removed and the limb thoroughly inspected, to detect, if possible, any uncorrected deformity, and to determine whether union is yet firm. In from four to six weeks repair in a healthy child or young adult should have been advanced to the stage of firm union. The apparatus should then be reapplied. At the end of the eighth week all apparatus should be finally removed. The thigh should be washed and thoroughly oiled. The patient should be permitted to lie in any position in bed without retentive apparatus for one week. After the splints are first left off and while the patient is still in bed daily systematic massage to the whole limb should be practised, together with slight passive and active motion at the knee-joint. The patient should not be allowed to bear weight upon the unprotected thigh until after the ninth week. At the end of the ninth week he should be allowed up and about with crutches, and a moderately high-soled shoe (two inches) should be worn upon the foot of the uninjured thigh. He should bear no weight upon the injured leg. The seat of the fracture should be protected by coaptation splints and straps and a light spica plaster-of-paris bandage from the toes to above the waist. At the end of twelve weeks all support may be discarded. Of course, fractures of the femur vary considerably in the time the patient is able to get about, but the foregoing routine is that of average uncomplicated cases. Some surgeons, however, would discard

all apparatus and get the patient up and out of bed, on crutches, within a shorter time than here indicated, but if error is committed it is infinitely wiser to err on the side of safety. It is very probable that massage without any passive motion, as early as the second week, to the region of the knee and thigh, will prevent much of the knee-joint disability and

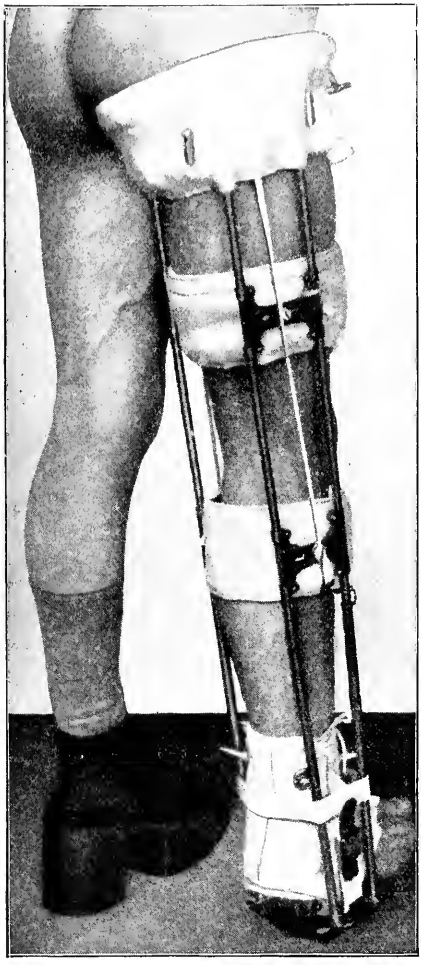

FIG. 92.—AMBULATORY SPLINT APPLIED.

FIG. 93.—PATIENT WALKING WITH AMBULATORY SPLINT.

muscular atrophy that so often hinder convalescence in these cases. It is very important also, in order to gain this end, to see that the extension is made from around and above the condyles of the femur, and not, as so often happens, from the knee-joint itself.

In the ambulatory treatment of fracture of the thigh by means of the ambulatory splint a high sole upon the shoe worn on the well foot, and crutches, are of very great value, especially in children and young adults. The hip splint, consisting of a long outside upright, with pelvic, thigh and calf bands, is applied with two perineal straps (see Figs. 92 and 93). The traction is made through the windlass at the foot-piece after fastening the extension strips to it. The counter-traction is made by the two perineal straps. The thigh is securely held by coaptation splints and a bandage about the thigh and splint. The patient goes about with crutches and a high sole of two inches upon the shoe worn on the well foot, bearing a little weight upon the foot of the splint. As a matter of fact, the real value of this method in fracture of the thigh lies in the improvement to the general health by the early getting into the upright position and out of bed. This application of the ambulatory method certainly is of great comfort to the patient. That it hastens the reparative process is yet to be fully demonstrated. If the hip splint is used, it should be applied when union is found to be firm. After wearing the splint in bed for a few days the patient may get up and about.

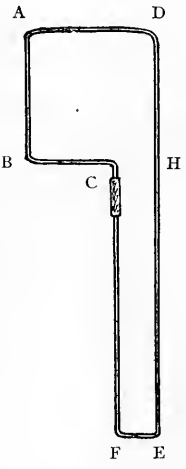

FIG. 94.—CABOT WIRE SPLINT FOR FRACTURE OF THE HIP AND THIGH. —(*Scudder.*)

Fracture of the Thigh in Childhood (Scudder).—This is usually caused by direct violence. The fracture is often incomplete. The symptoms are those of the same fracture in the adult. The effusion into the knee-joint is seen perhaps more uniformly than in the adult. This effusion disappears from the child's knee-joint more quickly than from the adult knee-joint.

TREATMENT.—After reducing the fracture,—making the incomplete fracture complete if perfect reduction can not be accomplished in any other way,—the problem of maintaining the reduction arises. In children of ten years and older it is possible to use Buck's extension. A plaster-of-paris spica splint from the calf of the leg to the axilla is also a possible method of immobilization.

In children under ten years of age the Cabot posterior wire frame with coaptation splints and extension is the very best method of conveniently and efficiently treating a fractured thigh or fractured hip.

The CABOT POSTERIOR SPLINT consists of two portions—a body part and a leg part. The patient lies upon the body part with the thigh and leg resting upon the leg part, as upon a coaptation splint. Having a vise and simple iron wire the size of an ordinary lead-pencil, this

FIG. 95.—THE CABOT WIRE SPLINT READY FOR USE.
Lateral view, showing curves of splint corresponding to small of back, buttock, and knee.—(*Scudder.*)

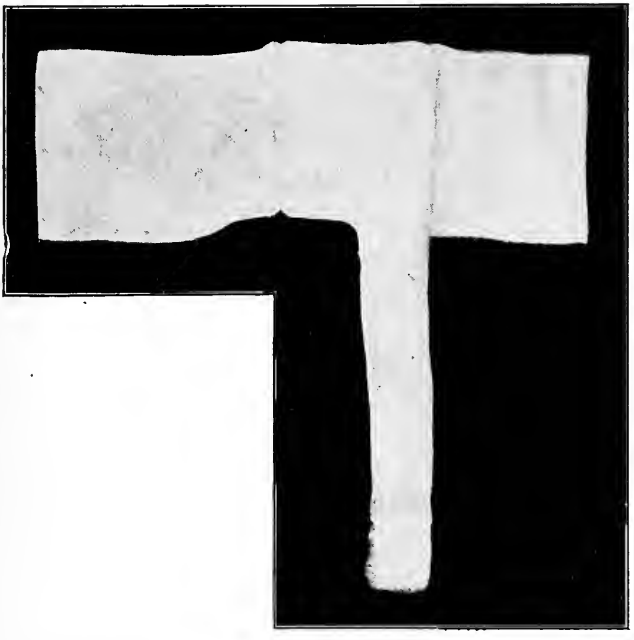

FIG. 96.—THE CABOT WIRE SPLINT READY FOR USE.
Front view, showing covering of canton flannel and canton-flannel double swathe for fixation to chest.—(*Scudder.*)

splint can be made in a few moments; the bending of the wire according to the diagram and fastening the free ends by a strip of small-sized wire being all that is required. It is necessary to make the following measure-

ments before bending the wire to the general shape shown in the diagram —namely, D E, the distance from the axilla to the calf of the leg; A D, the width of the trunk; A B, from the axilla to a point midway between the crest of the ilium and the top of the great trochanter; F E, the width of the leg, usually from two to two and a half inches. A D and B C are bent to the curve of the back. B C is so bent that it jumps over the sacrum and does not touch posteriorly excepting at B and C. The long rods are so bent as to adapt them to the posterior curve of the buttock, thigh, popliteal space, and leg (see Figs. 94, 95).

The splint is covered, as in the posterior wire splint for the leg, by layers of sheet-wadding and cotton bandages. A swathe is attached to the two sides A B and D H of the body part (see Fig. 94). The child is carefully laid upon this splint, the body swathes adjusted, the extension strips applied, traction made by weight and pulley with the foot of the bed elevated, coaptation splints applied and held in position by straps

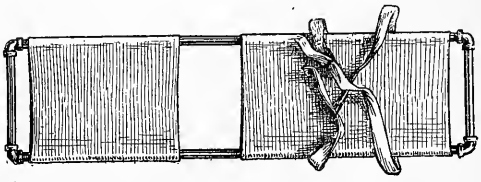

FIG. 97.—BRADFORD BED-FRAME FOR FIXATION OF TRUNK IN FRACTURE OF THE THIGH.—(*Scudder.*)

that include the posterior wire splint. If it is necessary to move the child for the making of the bed, for the use of the bed-pan, or for bathing, the extension may be unfastened temporarily without any injury to the fracture, particularly if the coaptation splints are then temporarily tightened to secure a firmer hold on the thigh. The child should be, of course, clean from both urine and feces, and the fracture immobilized.

After four weeks of bed-treatment the child may be up, with crutches and a high shoe with the Cabot splint applied. Shoulder straps should be attached to the splint when it is worn in the erect position. This is one of the simplest, cleanest, and most efficient methods of treating fracture of the thigh in young children. The child can be moved with freedom and without pain. A light plaster-of-paris spica bandage may be used in convalescence with crutches and a high shoe on the uninjured side.

In very small children it is sometimes wise to use the Bradford (see Fig. 97) frame and vertical suspension (see Fig. 98) of one or both thighs. This is an efficient, comfortable, and clean method of treatment. The Bradford frame is an iron, frame-like stretcher, on which the child lies and to which the shoulders and hips are fastened to prevent the child's moving about. Counterextension is then secured by the immobilization of the pelvis and hip. The extension is applied to the thigh and leg as usual. The limb is flexed on the body to a right angle, coaptation splints being applied to the thigh. After the novelty of the position passes away, the child is perfectly contented. As soon as union is firm, the permanent plaster spica dressing may be applied,

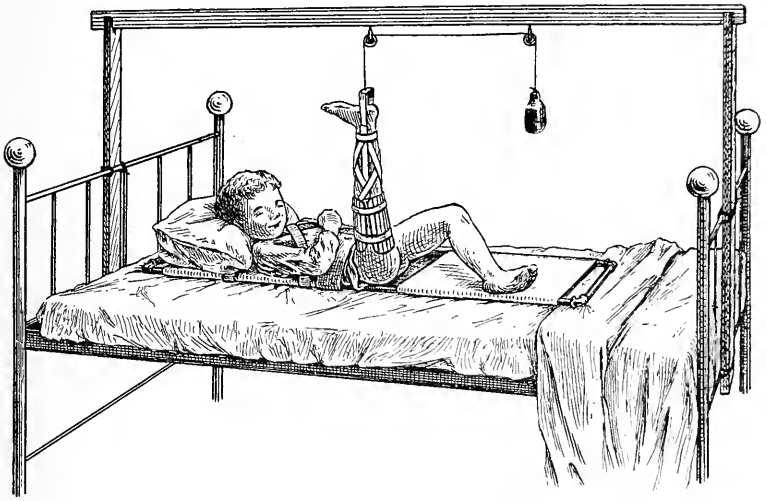

FIG. 98.—FRACTURE OF THIGH IN A CHILD.
Bradford frame. Vertical suspension of leg with weight and pulley. Coaptation splints to thigh and fixation of pelvis by towel swathe about frame.—(*Scudder.*)

and the patient may be up and about with a high shoe on the well foot and with crutches. The use of the long hip splint will be of great service in these cases either with or without the extension foot-piece (see Figs. 92, 93). After fracture of the shaft of the femur in children there should be no shortening and no especial difficulty in convalescence. It is wise to guard the thigh a sufficient time after union is firm to insure absolute solidity and freedom from bowing in any direction.

Complications during and after repair of fractures form a most interesting subject for observation and study. The complete

usefulness of a limb is not fully restored as soon as the fracture has been repaired. During the process of repair, as well as after union is complete, it is possible for many complications to arise and require special treatment.

Surgical Emphysema is a condition that is often encountered in the management of fractures. This consists of the entrance of atmospheric air into the meshes of the connective tissue, and is termed "surgical emphysema," to distinguish it from emphysema of the lung. The source of the infiltration of the air into the connective tissue may be from injury of the lung in fracture of the rib, in which case the emphysema has been observed to reach to the scrotum, and at times it may spread over the face so that the patient is unrecognizable. The air may escape to such an extent as seriously to embarrass respiration. Another source of emphysema may be from the generation of gases as a result of putrefactive changes or of the growth of gas-producing bacilli in the tissues. There are only a few cases observed of emphysema in simple fractures; the majority of the cases have been complications in compound fractures. Or the gas may escape from a wound in the intestine, or even from the air-sinuses in the bones of the face and skull.

If the emphysema arises from injury to the lung, no interference is indicated unless the emphysema is so extensive as to produce dyspnea, in which case free incisions can be made or the air allowed to escape through a trocar. The air is usually absorbed in a few weeks, and produces no harm, since it has been filtered in its passage through the lungs, and is therefore not likely to set up inflammation. In case the condition arises from putrefactive changes, the application of the principles of antiseptic surgery is required.

Edema consists of the infiltration of serous fluid into the interstices of the areolar tissue, and, unless it is due to some organic disease of the liver, kidney, or heart, is the result of too tight bandaging or the sudden removal of the splint, or, finally, of obliteration of the large veins from thrombosis. If due to local causes, the edema usually disappears after the removal of the cause, or, if to a loss of support of the vessels by the removal of the splint, the edema rapidly subsides as soon as the function of the limb is restored. Placing the limb under a faucet and douching it alternately with hot and cold water will stimulate the circulation; and this treatment, aided by massage of the muscles when the patient begins to walk, will relieve the condition.

Delirium tremens and traumatic delirium are two complica-

tions that frequently occur. The differential diagnosis is often difficult to make, but the tremor in the limbs and an alcoholic history occurring soon after the receipt of injury, with absence of fever, point to the former as contrasted with the latter condition. In both forms of delirium the patient has delusions, mutters incoherently, is often violent and excitable, and has a dry, tremulous tongue accompanied by free diaphoresis.

Treatment consists in placing the fracture at once in a plaster-of-paris splint or fixed dressing, and watching the patient carefully, even to the extent of employing a special attendant. If the delirium becomes too active and it is impossible to restrain the patient, a strait-jacket must be employed. If the patient is robust and young, liquor can be withheld; but if aged and feeble, it is necessary to continue stimulants with judgment. The bromids, chloral, hyoscyamus, and in some cases morphin, are the remedies which have proved the most successful. In organic disease of the kidney morphin is apt to cause suppression of urine, and must be employed with caution. The diet must be nutritious and abundant, and the patient's strength maintained.

It should not be forgotten that acute septicemia with rapid rise of temperature may cause delirium closely resembling that of trauma. Therefore, in the after-treatment of compound fractures, should delirium later supervene, the wound must be carefully examined for local signs of infection and treated accordingly.

Pneumonia is a complication likely to arise during the repair of a fracture. It is especially likely to occur in alcoholic patients with compound fractures, and forms a most serious complication. The treatment of the disease is conducted upon the same principles that govern the physician in a case of traumatic pneumonia (see page 47).

Osteomyelitis is a form of suppuration in bone, and is caused by the presence of septic micrococci in the wound. It is therefore most likely to occur in compound fractures, although the disease in the form of acute abscess may occur after any traumatism of bone. The osteomyelitis sets up necrosis of bone, and the patient may die from septic infection before the sequestrum can be removed. Septic emboli may start from the thrombi, and metastatic abscesses develop. The treatment of this condition consists in freely exposing the seat of the abscess and trephining the bone above it, if necessary, in order to reach the disease and establish free drainage, after which the wound is treated as heretofore described under "Septic Wounds."

Fat-embolism was first fully described by Wagner and Zenker. Fat-embolism means the entrance of fluid fat from the medulla of the bone into the veins in the immediate vicinity of the fracture, and through these channels into the capillaries of the brain, spinal cord, lungs, kidneys, and other essential organs. The presence of fluid fat in the blood was described in 1836 by R. W. Smith, but the clinical importance of this condition was not recognized until recently through the investigations of von Bergmann, Czerny, and Scriba. Déjérine has experimentally produced fat-embolism in the lower animals by inserting laminaria tents into the medullary cavity of the bone. The symptoms of fat-embolism appear on from the third to the fifth day, as a rule, and resemble those of secondary shock. They occur before the time at which venous thrombosis or pulmonary embolism would be expected to appear. Great dyspnea, associated with the Cheyne-Stokes respiration, irregularity of the heart's action, and a sudden rise of temperature, together with twitching of the muscles, as well as paralysis of certain muscles, have been observed in these cases, and also fat-globules are found in the urine. There have been no metastatic abscesses discovered where an autopsy has been made. This group of symptoms must not be mistaken for shock following fracture nor for pulmonary embolism. Shock may be said to be present three hours after the fracture, fat-embolism three days after, and pulmonary embolism three weeks after. For convenience these complications have been arranged in the order in which they are most likely to occur, and by associating these conditions, which simulate each other, with the time at which they appear, no mistake in diagnosis is likely to arise.

The treatment of fat-embolism consists in the administration of ether in the form of some such preparation as Hoffmann's anodyne, or even by hypodermatic injection. In case of great dyspnea venesection has been suggested, and also artificial respiration. The pulmonary edema must be relieved by cardiac stimulants and by cupping. The fracture should be kept perfectly quiet, lest any movement of the fragments might cause further absorption of the fat by disintegrating the medulla of the bone. In case there are great comminution of bone and disintegration of the medulla amputation may be immediately indicated as a life-saving expedient.

Gangrene of the limb may occur either as a result of mechanical or traumatic causes or from septic infection. Gangrene arising from mechanical causes is due to the application of too tight a splint or band-

age or to the improper and prolonged use of a tourniquet. The gangrene resulting from traumatic causes is due to a crushing or laceration of the soft structures near the fracture, or else to the rupture of the main vessels by the same agency which produced the fracture, or by the sharp fragments of bone, or, finally, to pressure from hemorrhage or from an unreduced fragment. The occurrence of gangrene in the treatment of fractures often leads to suit for malpractice. It is therefore important for the surgeon to define clearly the causes over which he has control, and those which are beyond his control, such as contusion, laceration of bloodvessels or nerves, pressure of a fragment of bone, or the obliteration of the lumen of the artery from thrombosis due to senile changes or calcification of the artery, and the presence of diabetes, with which gangrene is so often associated, especially after an injury.

The treatment must depend upon the cause, extent, and the general condition of the patient. In small, localized areas of gangrene measures should be adopted to encourage the separation of the slough, while in gangrene with a line of demarcation forming, amputation can be resorted to when the healthy and dead tissues are clearly defined. In case of rapidly spreading gangrene, with symptoms of serious septic intoxication, amputation high above the gangrene should be immediately performed.

Pyemia and septicemia are conditions which arise in the course of the repair of a fracture, and for a full description of these complications the reader is referred to the article devoted to a consideration of this subject.

Thrombosis is a complication that under rare circumstances occurs. When a vein has been wounded a clot forms which closes the vessel. From this thrombosis an embolus may travel to the lung, where it may occasion death by plugging the pulmonary artery. This complication occurs without any warning, usually about three weeks after the receipt of the fracture. The patient expires suddenly with great dyspnea, cyanosis, feeble pulse, and cardiac pains. It occasionally happens that small emboli may become detached, and produce alarming symptoms which gradually disappear. In all cases in which there has been obliteration of the veins, with formation of thrombi, it is dangerous to practise massage early or to disturb the seat of fracture, since an embolus might be torn away from the thrombus and set free in the circulation.

Atrophy of the limb following fracture is a complication that is likely to occur, especially when there has been long-continued dis-

use of the limb, as in fracture of the patella. The atrophy is most marked in the muscles above rather than in those below the joint nearest to the fracture, and it is especially prone to appear in rheumatic diathesis and to involve the extensor muscles. The atrophy involves the connective tissue as well as the muscles, and the condition may be dependent upon an injury to the nerves in the limb, or possibly to a prolonged use of continuous compression. The atrophy is susceptible to treatment by gentle massage, hypodermatic injection of strychnin, shampooing of the limb, and moderate exercise.

Paralysis of the muscles below the seat of fracture may occur as a complication during the repair of fracture, as a result either of associated injury to the nerves supplying the affected muscles, or of an inclusion of the nerves in an exuberant callus during the process of repair. In the former case the paralysis is present simultaneously with the occurrence of the fracture, and if the nerve is a mixed one there will be loss of motion and sensation. The simple tests for motion and sensation should be made in examining every case of fracture, since a paralysis which is overlooked at the time of the examination of the fracture may be attributed subsequently to carelessness on the part of the surgeon. In case paralysis is due to pressure, electric stimulation of the main nerve-trunk above the callus fails to excite the muscles to which the nerve is supplied.

The treatment consists in extricating, if possible, the nerve from the callus by means of a surgical operation, and the application of the constant current to the nerve until it has regained its function.

Ankylosis of joints occurs as a complication following fracture. The ankylosis may be either permanent or temporary. The permanent variety consists of an osseous ankylosis, and the condition is a result of a fracture directly into the joint, so that the fragments within the joint have become united. For the removal of this condition surgery can offer no relief unless an aseptic resection of the joint is performed, and this operation is limited to joints like the shoulder, elbow, wrist, and ankle, and possibly a few others. The temporary ankylosis is the result of a concomitant injury which has set up an arthritis, or it may be due to the prolonged use of extension in the treatment of certain fractures, or it may be the result of hemorrhage into the joint which has excited a synovitis and arthritis with the formation of intra-articular bands of fibrous tissue. In Colles' fracture the fingers are often stiff from a thecal inflammation, and it is with great difficulty that this condition can be relieved.

The treatment consists in massage, shampooing, the use of hot fomentations of bran, the alternate douching with hot and cold water, and active movement. It should be remembered that passive motion must be begun early, but with the utmost care, in case a fracture invades a joint or is so near that the callus is likely to involve the joint. In Colles' fracture passive motion in the fingers should start from the first, and at the wrist after one week. In no ordinary case of fracture should passive motion be delayed more than two weeks, unless delayed union or nonunion is apparent.

NECROSIS OF BONE occurs as a complication during the repair of fracture, and is due to the fact that the periosteum has been detached from the fragment or from the shaft of the bone. In the former case the loose fragment should be removed at the time of the reduction and first dressing; in the latter case the superficial scale of bone undergoes necrosis, owing to its diminished vascular supply. Generally a sinus leads down to the exfoliated bone. This tract should be excised and the bone removed, as a long-continued sinus discharging ichorous pus is a condition favorable to the development of an epithelioma.

THE CAUSES OF NONUNION IN BONES after fracture are constitutional and local. Among the *constitutional causes*, in which the reparative action is impaired or misdirected, may be mentioned old age and certain constitutional diseases, as fevers, syphilis, scurvy, malignant disease of bone, and rickets. Paralysis may also be a cause, as is illustrated by a case of spinal injury with fracture of the humerus and leg of the same side, in which the arm united, but the leg failed to unite.

Among the *local causes* of nonunion may be mentioned the direction of the line of fracture, since oblique fractures are more frequently attended by failure of union than transverse or impacted. Among the other causes may be found separation of the fragments, the interposition of foreign bodies, muscle, tendon, or fascia, between the ends of the broken bones, or suppuration, profuse hemorrhage, the continued use of wet dressings, and, finally, improper dressings, in which the splints are either too tight or too loose. The rupture of the main nutrient artery at the time of fracture may result in nonunion.

The treatment of nonunion of bone following fracture is to be considered from a constitutional as well as a local point of view. It is the combination of general and local treatment that is most apt to bring about the desired object. In every case a careful inquiry should be made in regard to certain so-called diatheses. The treatment of

this condition has for its object the correction of any constitutional dyscrasia. A syphilitic diathesis should be treated with the full administration of antisyphilitic remedies; a gouty or rheumatic tendency, by remedies suited to these special diseases; scurvy, rickets, scrofula, tuberculosis, and marasmus should be treated with tonics and a nutritious diet, with the aid of the best hygienic surroundings. The tonics best suited for those conditions in which the general health is impaired are iron and the phosphates.

In conjunction with the general management the local treatment is to be pursued. The means employed must consist of the removal of any offending body between the fragments and the excitation of a certain amount of inflammation around the ends of the fragments. The local treatment must further consist in the application of an immovable splint specially adapted to the exigencies of the case.

The operations which have been devised with a view to effecting union in ununited fracture are multifarious. They all have one common object—viz., the excitation of inflammation; but many of the old operations are at the present time abandoned as a result of the introduction of antiseptic surgery. The use of the seton, the injection of irritating fluids, the cauterization of the fragments, the application of blisters and of caustic alkalis to the skin over the site of the ununited fracture, the introduction of electric currents, the violent percussion with the mallet—are among the various operations which are practically discarded as unsuitable, and in their places modern surgery has instituted a number of aseptic operations, for description of which the reader is referred to works of general surgery.

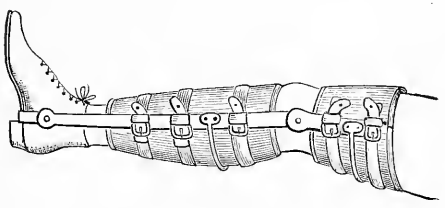

Fig. 99.—H. H. Smith's Splint for Ununited Fracture of Leg.—(*Dennis.*)

Fracture of the Patella.—Fractures of the patella, whether simple or compound, are usually accompanied by more or less profuse swelling, which makes its appearance ordinarily within three or four hours following the receipt of the injury, the swelling being due to the accumulation of blood and synovial fluid in the knee-joint. Before any method is resorted to with a view to bringing the fragments into apposition, the surgeon must endeavor to control and modify the joint

inflammation. The ice-bag is used with great benefit during the first day or two, after which lead-water and laudanum wash may be used. So soon as the inflammation and swelling have subsided, uniform pressure by means of an elastic bandage will hasten absorption of the fluid. The limb can be so placed by slightly elevating the leg that the position alone will afford an excellent method of treatment. The limb may be elevated and placed upon a well-padded Hamilton splint, or an ordinary inclined plane splint (see Fig. 100), so that the foot

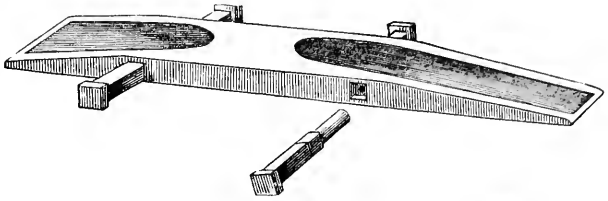

FIG. 100.—INCLINED PLANE SPLINT.—(*Dennis.*)

is from one to two feet above the foot of the bed, and in this way the rectus, crureus, and vasti are relaxed, and there will be no traction upon the upper fragment. No operative measures should be attempted until the inflammatory action has subsided, unless the fracture is compound, when the operation of fixation of fragments should be performed.

There are two methods of treating fracture of the patella—one is called the *expectant* plan, and the other the *operative* treatment. In the expectant plan or method of treatment the lower fragment is fixed by means of adhesive straps or other appliances placed obliquely about the leg and splint, and fastened to the splint above the fragment, either a ham-splint, an Agnew splint, or a Cabot posterior wire splint having first been adjusted to the posterior surface of the limb.

TREATMENT BY THE EXPECTANT OR NONOPERATIVE METHOD.—During the first four weeks fixation of the knee, elastic compression, douching, massage, the thigh flexed slightly on pelvis, the leg extended, retentive straps, coaptation splints, are the measures employed. At the fourth or sixth week remove all apparatus, apply removable splint, allow walking with crutches, and use daily passive motion. At the eighth week discard crutches, use cane, and permit limited daily active motion. At the sixth month discard splint, apply flannel bandage, and discard cane. At the eighth to the tenth month remove all support. (Scudder.)

The operative treatment consists in the reduction and fixation of the fragments which are held in place by wire or animal sutures, after which the limb, in an extended position, is immobilized by some fixed dressing. If the operation is performed with aseptic precaution, the drainage may be removed on the second or third day.

Postoperative Treatment.—At the end of about four or six weeks from the injury union will be found. The retentive straps and coaptation splints should now be removed, and the leg immobilized by a plaster-of-paris splint extending from below the calf of the leg to the groin. Fixation (prevention of flexion and extension) on walking is to be maintained for at least six months after the injury. Protecting the knee thus when walking for this period of six months does not preclude active movements of the knee when not bearing weight upon the limb. At the end of that time the patient may be allowed to go about with a cane and a snugly fitting roller bandage. This bandage should

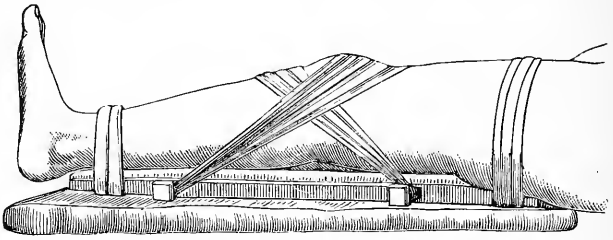

Fig. 101.—Agnew's Splint Applied.—(*Dennis.*)

be made of medium weight flannel, cut straight with the weave and not on the bias. The bandage should be applied from the middle of the calf of the leg to the middle of the thigh when the leg is completely extended. As the patient becomes confident of his strength, the cane need not be carried. Sudden movements are to be avoided. At the end of eight or ten months, varying with the individual case, all support may be omitted from the knee.

The Restoration of the Function of the Joint.—From the day of the injury daily massage to the whole limb is important. It maintains the muscles in good tone. It prevents adhesion of the fragments to the tissues about the condyles of the femur, a not uncommon cause of ankylosis of the joint. It facilitates the absorption of the effusion of blood and synovial fluid. After the fourth week daily passive motion is to be instituted—at first very slight indeed, barely two or three degrees. If the relative position of the fragments is not altered

perceptibly by this passive motion and lasting pain is absent, it may be persisted with in regularly increasing amounts. At the expiration of eight or ten weeks active motion at the knee-joint may cautiously be allowed. The appearance of persistent and increasing tenderness, sensitiveness, or pain, and increasing separation of the fragments are the indications to diminish or cease passive and active motion.

CHAPTER XVI.

AMPUTATIONS.

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General Remarks.—Modern surgery seeks not only to insure healing by first intention in an amputation, as in every other operation, but also to leave a functionally useful stump. A stump, to be functionally useful, must be capable not only of bearing weight and pressure, but also of movement. But in satisfying these demands we only fulfil part of our endeavors. The first essential for the usefulness of a stump is freedom from pain; the second good nutrition, so as to prevent atrophy of the muscles and bone.

If in recent times we have obtained more useful stumps than formerly, we are indebted, in the first place, to asepsis. Smooth and painless cicatrices can only be got when the wound heals accurately and without infection, for it is the thick, dense cicatrices resulting from an inflammatory condition of the wound that are painful. The worst of all, however, are the irregular hypertrophic inflammatory scars with overgrowth of bone. For this reason, as well as because of the dangers of infection and the discomforts of delayed union, we should do all in our power to insure healing by first intention. (Kocher.)

We shall not here again consider the treatment of wounds, but we may refer the reader to the chapter on the subject at the beginning of the book. We would again point out, however, how important it is that clean incisions should be made whose edges can be accurately fitted together. Numerous experiments under the direction of Tavel have clearly proved that lacerated and irregularly torn wounds are much more prone to be infected by a definite number of organisms than are those which are cleanly cut. Consequently, as absolute freedom from germs in the wounds which we make cannot at present be attained, the chances are that a clean and properly conducted amputation will heal without reaction, while one in which the technic is poor will suppurate. Thorough arrest of hemorrhage and proper drainage always help to insure a good cicatrix.

But even though we avoid infection and escape a hypertrophic,

needlessly thick, dense cicatrix, every stump is not a serviceable one. The cicatrix even of a wound which has healed by first intention will remain sensitive if it is exposed to special mechanical injuries, such as traction, or pressure, conditions met in cicatrices on the trunk which are injured by the movements of the body and the pressure of clothes. Pressure and traction are to be avoided, especially when an artificial limb has to be worn.

The cicatrix is exposed to most pressure if it lies between the bone and the artificial limb or any external object. The muscles and tendons inserted into the cicatrix exert most traction on it if it is fixed to an immobile structure, especially to the bone. To avoid painful pressure the scar should, therefore, not lie under the end of the bony stump in any case in which it is to be utilized to bear weight or pressure. The only incisions which meet this indication are the oblique incisions and their modifications, as illustrated above. It is only by dividing the soft parts deeper on one side than the other that one can get a cicatrix placed where no pressure can be exerted on it.

It should be noted that this applies not only to the skin, but also to the deeper soft parts, the fascia, muscles, tendons, and periosteum. These layers must also be divided obliquely if the scar is not to lie on the pressure surface. We grant that scars vary in sensitiveness, those of muscle being less sensitive than those of skin; but, again, a scar in periosteum behaves quite differently, because of the great sensitiveness of this membrane, which, moreover, is easily stimulated to permanent proliferative changes by mechanical irritation. It has already been noted that the cicatrices on the ends of nerves (the most sensitive parts of all) are best kept out of the region of the stump by division of the nerve higher up.

Therefore the united surfaces of the soft deeper parts (including the periosteum) should not be situated directly over the end of the stump. This is a point which up till now has not been specially attended to in the periosteo-plastic method. But even although the operation be properly performed by means of the oblique method, there still remains a possible source of pain in the stump, dependent on the shape of the bone. If sharp corners and edges are allowed to remain, which are driven into the soft parts by the weight of the body, there will always be a painful stump. Fortunately this is less likely to occur if the scar does not lie under the bone. It has been rightly pointed out that in Syme's amputation of the foot a stump capable

of bearing the weight of the body is provided if the malleoli are not sawed off. This can only be obtained if one distributes the pressure on the less prominent bony parts. No one would be able to walk if supported only on the apex of the most prominent point, the external malleolus.

In the face of this fact it can be easily understood why, by the older methods, we so often got serviceable stumps at the epiphysis (as Hirsch has shown, but for a different reason) and so rarely in the shaft of a bone. The epiphysis can easily be rounded off, and this should always be done, so that the pressure from below may be distributed equally over a large surface. We maintain expressly that by this means painless and very useful stumps may be obtained in amputations above the malleoli and through the condyles of the femur without any osteoplastic operation, provided care be taken that the soft parts covering the stump are movable and do not contain a scar.

In the case of the shaft of a bone it is extremely difficult to attain this rounding off. We have to do here with a tube with a hard exterior; and if we do round it off, we simply transfer the edges from the outer surface of the bone to the medullary surface. But the main point is that a really well-rounded stump in the shaft is technically very difficult to get. We have not yet got sufficient evidence as to how far a carefully rounded section through the shaft, which is covered with scarless periosteum and scarless soft parts, is really adapted to bear weight without giving pain.

Hirsch must be recognized as having called attention to the fact that stumps which have been stripped of periosteum are quite useful. In his method, as in the most ancient methods, Hirsch does not preserve the periosteum. He makes no osteoplastic nor even a periosteoplastic covering, but leaves the end of the bone bare of periosteum, and it is interesting to learn that at the Surgical Congress in Berlin, 1901, his method found eloquent supporters. Bunge, from Eiselberg's clinic, declares that it is injurious to cover the stump with the sensitive periosteum, and that, on the contrary, it should be removed, as the stump will then be much more useful, because less sensitive. On the same grounds Bunge scrapes out the medulla, so that this sensitive part may not be pressed upon.

Bier is convinced that it is harmful to operate subperiosteally, because of the resulting overgrowth of bone. But as he prefers the osteoplastic to the older methods, it follows that it does not signify

much whether the periosteum is removed, or whether it is replaced over the sawed surface. The point is that a good stump may be formed in various ways, provided the end of the bone is rounded, broad, and smooth, and has no corners or edges to exert pressure on sensitive parts. But another point which has been too long neglected is that it is essential that the stump should retain the good shape given to it at the operation.

For if one wishes to prevent injurious growth from the medulla or from the bone itself, the stump must be subjected as early as possible in the functional relationships to which it will later be exposed. The irregular overgrowths which are sometimes described will then not occur, because functional activity determines the direction of cicatrization.

If the wound heals rapidly by first intention, strong and serviceable stumps can be assured, be they aperiosteal, subperiosteal, or osteoplastic, by taking care that the skin-cicatrix, the fascial scar, the stump of the nerves, and the muscle-cicatrix are away from the seat of pressure. This can be effected by the oblique oval method of incision, by making the end of the bone broad and round, by causing it to press against portions of muscle and skin which are only slightly sensitive, and by accustoming it early and carefully to gradually increased pressure. The best stumps are always those in which the skin and periosteum covering the face of the bone retain their normal relationship to each other, as in Bier's or Pirogoff's osteoplastic operation, especially if the skin is already accustomed to pressure, as in Gritti's operation and Kuster's modification of Pirogoff's amputation.

Besides the necessity of preventing pressure on the scar, we must direct attention to the necessity of preserving the scar from traction. The scar is pulled on by the movements of a stump only if it cannot follow those movements, and this especially happens if it is adherent to the firm resisting bone.

If, therefore, in addition to the normally adherent periosteum, the normally movable soft parts, especially the sensitive skin, become adherent to the sawed surface of the bone, pain will naturally occur on movement. But if one covers the sawed surface with periosteum, retaining its normal relation to the soft parts, adhesion of the latter in the course of cicatrization is prevented. As already seen, this adhesion happens only when one has separated the soft parts from their normal relation to the flap of periosteum. In this lies the chief value

of the periosteo-plastic method, and to a considerable extent of the osteoplastic method. The latter is preferable to the former in all cases in which the shaft is divided, because it makes it easier to obtain a rounded-off stump. The layer of bone which is applied to the sawed shaft does not require always to have a very regular surface as long as it has no sharp corners or edges.

Bier has called attention to the necessity of accustoming a stump to pressure early, and using it soon, so as to prevent atrophy of the bone and soft parts. Atrophic stumps are sensitive, just as are atrophic limbs on which no operation has been performed. But it is of equal importance that the growth of the end of the bone should be prevented from forming projecting angles, and thus interfering with the functions of the stump. It is because there is so little danger of exostoses and hyperostoses forming on the end of a bone when the amputation has been done by Hirsch's aperiosteal method that the stumps are so efficient in bearing weight. Bier's requirement, therefore, applies especially to periosteo-plastic stumps, but also to all stumps in which primary union gives opportunity for early use.

The principle of preventing hypertrophy of scars, pressure and traction on a scar, and atrophy of the soft parts, allows us to formulate the following:

Procedure for a normal operation: An oblique incision (combined, if necessary, with a longitudinal one in the form of a racket or lanceolate incision, *E*, *F*, *G*, Fig. 102) through skin and fascia. After retracting the elastic skin the muscles are divided obliquely down to the bone. The periosteum is also to be divided obliquely. The periosteum is then separated, along with the superficial layer of the cortex of the bone, by means of a sharp raspatory or chisel, or, when possible, a flap of bone having a movable periosteal hinge is made by means of the saw; lastly, if only a thin shell of the cortex has been raised up along with the periosteum, the end of the bone is simply rounded off, while if a distant flap of bone (osteoplastic method) has been sawed up, the end of the bone must be sawed in a curved direction so as to fit it. The periosteal or bony flap is sutured over the sawed surface of the bone to its periosteum. The stumps of the muscles or tendons are sutured to each other or to the surface of the bone at a distance from the sawed surface. Lastly, the skin and fascia are sutured. But in cases in which a periosteal flap, or a flap of bone and periosteum, cannot be obtained in normal relation to the other soft

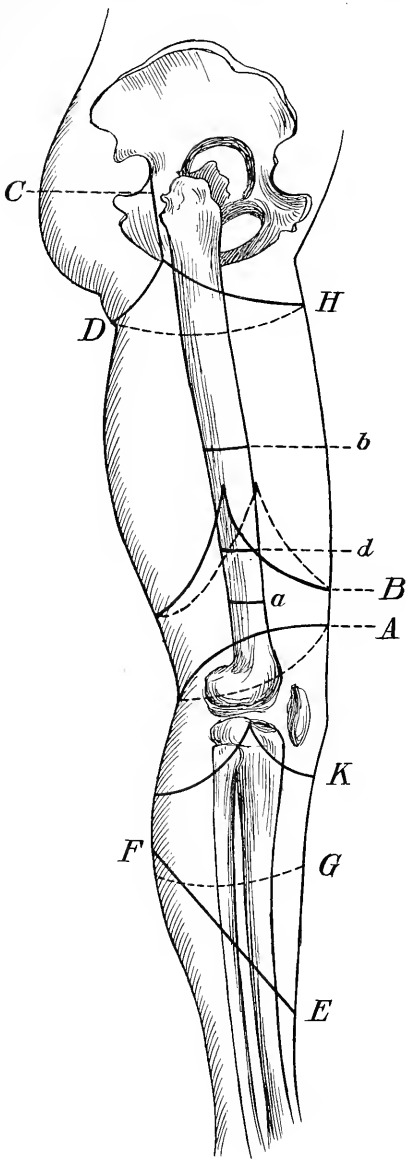

FIG. 102.—ILLUSTRATES VARIOUS METHODS OF AMPUTATION.

A, Circular amputation of thigh; *a*, saw line; *B*, amputation by equal flaps; *b*, saw line; *D*, posterior incision for disarticulation of hip; *C*, racket incision; *E F* and *F G*, racket incision of flap with circular method for muscles and bones; *H*, amputation of hip, equal flap method; *K*, Stephen Smith amputation at knee.

parts, it is better to remove the periosteum entirely from the end of the stump, to scrape out the medullary cavity (according to Eiselberg and Bunge), and to round off the edges of the bone as dentists do.

American surgeons, as a rule, now pay very little attention to the hard and fixed lines formerly laid down by surgical guidance in amputations. The particular method of amputation adopted for any given case now depends not upon the surgeon's predilection for any one form of incision or kind of flap, but upon the actual condition of the parts; thus in railroad injuries or amputations following injuries the main idea in the surgeon's mind is how to insure the best stump that shall be as useful as possible. Not only will he save all that is possible of the limb, but will often shape his flaps in an irregular manner so as to obtain a longer and more useful stump. By the proper employment of antiseptics, inflammation and sloughing of the stump have been greatly diminished, while the danger of secondary hemorrhage has practically disappeared. It is now possible to fashion flaps from tissues that have been bruised by injury if their vitality has not been markedly interfered with, which heretofore it was not thought possible to save.

Another noticeable feature in present-day methods is the increasingly frequent use of skin-flaps and the diminution in the amount of muscle employed to cover the bone. (Cheyne-Burghard.)

While it is well to be intimately acquainted with all the typical methods of amputation suitable for different situations, it is of extreme practical importance for the surgeon to remember that he can modify any of these to meet the varying circumstances of any individual case, and that he may use lateral, oblique, or irregular flaps according to the nature of the case with which he is dealing, so long as he is thereby enabled to provide a satisfactory stump without sacrificing more of the limb than is absolutely necessary. While no doubt the set operations may be followed to advantage in aseptic cases or for diseased conditions, the patient's interests are better served in the majority of cases in which the surgeon is nowadays called upon to amputate, by some irregular form of amputation than by one on old-fashioned lines (Fig. 103).

There are two methods employed which affect materially the after-care or postoperative treatment, namely, the *closed* and *open* methods, the former being applicable to all aseptic cases, the latter, chiefly to railroad injuries or septic cases.

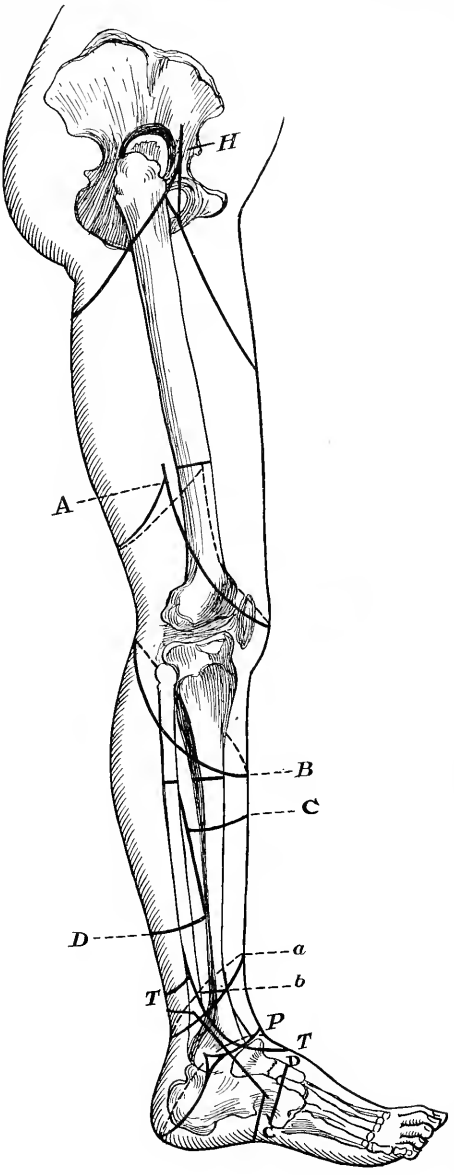

FIG. 103.

A, Amputation of thigh, long anterior and short posterior flap; *H*, anterior incision for disarticulation of hip, anterior and posterior flap; *B*, disarticulation of knee, elliptic incision (Bauden's operation); *C D*, Lee's amputation of the leg; *T T*, Teale's amputation of leg; *P*, Guyon's supramalleolar amputation.

All cases require the ordinary aseptic precautions, such as shaving, scrubbing thoroughly, and disinfection of the field of operation. The entire limb except the field of operation should be carefully wrapped in disinfected towels which should be fixed in position by safety-pins or a roller bandage. After the arteries have been ligated with double catgut ligatures, and all hemorrhage or oozing checked, preferably by hot normal salt irrigation, after the insertion of a small drainage-tube at the most dependent portion, the muscles may be brought in apposition by means of catgut sutures and the skin-flaps closed with silkworm-gut and fine horsehair sutures.

FIG. 104.—AUTHOR'S METHOD OF DRESSING AFTER AMPUTATION.

Illustrates manner of applying fixed bandage over the rubber tissue or jaconet. The rubber tissue is then folded back, exposing the stump, and protects the fixed bandages. The exposed stump is then ready for the dressing and a second bandage is applied.

Dressings.—The ordinary iodoform, xeroform, or cyanid gauze dressings may now be applied. Care should be taken to have a sufficiently large amount to cover the parts thoroughly. Over this is placed a layer of sterile absorbent cotton, and, lastly, plain sterile gauze, over which a careful bandage should be applied with some degree of firmness to obviate the spasmodic jerking of the muscles of the stump.

This latter is also obviated, with much comfort to the patient, by applying a splint to the remaining portion of the amputated limb.

After aseptic amputations it is our custom to make the first change of dressing the sixth or eighth day following the operation, when the drainage-tubes may be withdrawn. The wound should be again dressed as before with several layers of gauze, cotton, etc., and remain undisturbed for six to eight days. By the end of this time, or the fourteenth day, the silkworm-gut sutures may be removed, and if there is no evidence of infection, narrow strips of sterile adhesive straps

FIG. 105.—SHOWS THE RUBBER TISSUE FOLDED BACK OVER THE FIXED BANDAGE, READY FOR THE DRESSINGS.

The fixed bandage not only affords a good hand-hold, but prevents relaxation of the muscles and enables the temporary dressings to be removed with little disturbance or pain to the patient.

may now be applied with sufficient firmness to mold or give the proper shape to the stump. Over these may be placed layers of antiseptic dressings, and a snug bandage applied.

In the second class of amputations, in which more or less sepsis is unavoidable, after all oozing has been controlled one or two stitches of silkworm-gut may be taken at either angle of the wound, the center of the wound being left open. It is now carefully but gently packed

with iodoform gauze down to and well covering the end of the bone. If it be a leg or thigh amputation, it is our custom before applying the dressings to cover the limb with sterilized guttapercha tissue (see Fig. 104), leaving it extended over the wound five or six inches (see Fig. 105). We then apply our permanent bandage, commencing four or five inches from the line of amputation, placing the bandage well back over the limb as high up as necessary, and securing this with safety-pins. The guttapercha extending over the amputated part is now folded back over the permanent bandage. We now apply several layers of iodoform gauze over and around the open stump. Over this are placed absorbent cotton and sterile gauze, and, lastly, a bandage is placed as snugly as possible over the dressings and extended back over the other or primary bandage. The primary or supporting bandage holds the tissues snugly together and furnishes a hand-hold and enables the other dressings to be removed with less annoyance and pain to the patient.

After-treatment of Septic Cases.—The dressings should be changed on the day following the operation, as there is usually a considerable amount of oozing during the first twenty-four hours. The frequency with which the dressings require changing subsequently will depend upon the amount of discharge. No attempt should be made to remove the gauze drainage from the wound before the fourth to the sixth day, and only such as becomes loosened should be removed. From the sixth to the eighth day the entire gauze drain will become loosened and should be removed, the wound being again gently packed.

Healing of the wound is usually rapid, so that by the eighth to the fourteenth day the wound may be drawn together by means of sterile adhesive straps. The straps are applied with the object of shaping or molding the stump and to guard against too wide separation of the flaps. If the suppuration has been excessive, irrigation with Thiersch's solution may be necessary, but ordinarily it is best to avoid any form of irrigation or moisture, the wound being kept clean by wiping it carefully with gauze sponges dipped in hot normal salt solution, and after drying the stump as carefully as possible, a dusting-powder of zinc stearate may be used and will greatly facilitate healing.

Amputation of the thigh or leg by the closed method requires fourteen to twenty-one days to heal. When the open method is employed, three to six weeks are usually required before patients can be discharged.

Faulty Stumps.—Postoperative Complications.—A stump may be faulty from either of three conditions: namely, (1) adhesions of the cicatrix to the end of the bone, (2) involvement of sensitive nerves in the scar tissue, or (3) from a formation of what is called conical stumps.

Should the scar become adherent to the bone, there is often great pain on pressure. This may occur even though the larger nerves have been cut short, and is then due to the implication in the cicatrix of the smaller nerve branches which may become bulbous and give rise to excessive pain. (Cheyne.)

Quite apart from the neurotic condition of the stump in which the cicatrix is adherent, there is usually persistent and often spreading ulceration in the scar, owing to the low vitality of the cicatricial tissue, which later breaks down upon the slightest pressure. This may leave a granulating surface very difficult to heal. In stumps of this kind the nutrition of the entire end of the stump is defective. It is cold, livid in color, and is very liable to be affected by low forms of inflammation and obstinate ulceration, or the faulty nutrition may give rise to eczema, in which case there will be a sticky, watery discharge. These cases are frequently very obstinate and in the end may call for a reamputation.

Treatment.—In all cases of adherent cicatrix much time and useless suffering on the part of the patient may be saved by reamputation, and a far better result is obtained by performing an entirely fresh amputation and fashioning new flaps than by simply opening up the wound and repacking a portion of the bone. If such a partial operation is done, the nerves are still left implicated in the cicatrix and fresh adhesions between the layer and the bone are very apt to occur; hence in all cases, except possibly in those in which a reamputation would involve the loss of a joint, it is better to fashion fresh flaps which do not contain any scar tissue. Where, however, an important joint, such as the knee-joint, may have to be sacrificed, if fresh flaps are to be made, or in case the patient objects to further amputation, recourse should be had to exfoliation of the tissue by means of an ointment of resorcin, one dram to the ounce, followed by applications of zinc oxid, bismuth subnitrate, or calomel. If these do not suffice to heal the stump, the removal of a portion of the bone after opening up the old cicatrix may prove efficient.

Conical Stumps.—The so-called conical stumps result from one of three causes. In the first place, the flaps may have been so badly

planned at the time of the operation that they could be brought with difficulty over the end of the bone, the result being that if the muscles contract or slough the skin becomes more and more tightly stretched over the end of the bone, and the stump therefore becomes conical. Secondly, the condition may result from excessive sloughing or contraction of the muscles after an amputation in which the flaps have been accurately fashioned at the time of the operation. This frequently occurs in muscles of subjects in whom healing by first intention has failed. Lastly, it is a common occurrence in young subjects in whom a perfectly successful amputation has been performed through bones in a condition of active growth. The stump gradually becomes more and more conical. As time goes on, this condition appears to depend

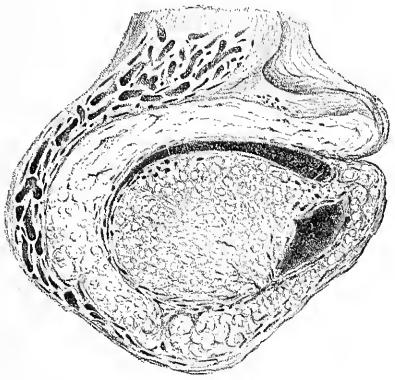

FIG. 106.—TUBERCULOUS DISEASE OF THE EPIDIDYMIS WITH MILIARY DEPOSITS IN THE TESTES.—(*Moullin.*)

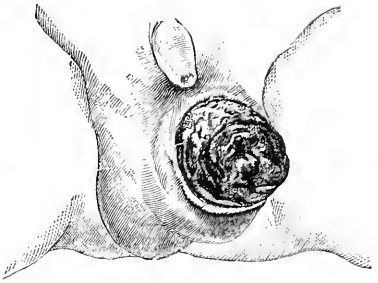

FIG. 107.—HERNIA OF THE TESTICLES FOLLOWING TUBERCULOUS DISEASE; REMOVED FROM INFANT, ÆT. TWO.—(*Moullin.*)

on want of proper relation between the development of the soft parts generally and the growth of the bone. (Cheyne.)

Treatment.—The only rational treatment is to open the wound and to remove as much bone as may be necessary to make a satisfactory stump. The amount or extent of bone removed must, of course, vary with the age of the patient. An older person will not require so great a removal as a younger person, in whom the bone may be expected to grow considerably.

Postoperative Changes Following Amputations.—The muscles become atrophied, and their divided extremities are found to be embedded in a mass of sound fibrous tissue. Those whose functions are

abolished are more or less entirely converted, in process of time, into connective tissue. Such as retain any capacity for action retain to a corresponding extent some muscular structure.

The divided bone becomes rounded off; the medullary canal is closed either by bone or by fibrous tissue. The extremity becomes either atrophied and pointed, or presents an abnormal enlargement due to a development of bone from the periosteum. The new bone in some stumps forms a button or mushroom-like extremity for the shaft. In other instances the new bone-formations are scanty and spicular, and play the part of foreign bodies in the stump.

The whole shaft of the bone wastes. After an amputation through the knee the femoral condyles may entirely disappear; and in an amputation above that joint, not only may the shaft and trochanters become evenly atrophied, but this retrogressive change may extend to the pelvic bones of the same side. After a disarticulation the cartilage left upon the bone atrophies and becomes fibrous, or entirely disappears in the course of years.

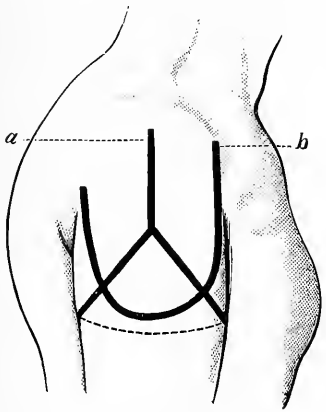

FIG. 108.—DISARTICULATION AT THE SHOULDER.
a, Oval method; *b*, method by deltoid flap.—(*Dennis.*)

The nerves undergo a like atrophic process. The true nerve-fibers disappear to a variable extent, and are replaced by connective tissue. This change may extend to the spinal cord and even to the nerve columns concerned. The divided extremities of the nerves may become enlarged and form considerable bulbous terminations. It may be here said, however, that this condition is not necessarily associated with tenderness of the stump.

The collateral circulation is soon restored in the limb after the high division of the main artery. That trunk in time attains to such dimensions as are demanded by the vascular needs of the part. Some years after an amputation at the hip by an anterior flap the portion of the femoral artery left in the stump will probably be no larger than the radial. The wasting of the main arterial trunk may be attended by an overdevelopment of certain of its branches, so that after a lapse of time the principal artery may be difficult to identify on dissection.

AMPUTATION AT SHOULDER-JOINT.

After-treatment.—A drainage-tube will be required, as a considerable amount of fluid commonly escapes from the synovial membrane which is left behind. This complication may be avoided by dissecting the membrane out carefully at the time of the operation. Pressure should be applied to the outer flap after the stitches have been introduced, in order that the great cavity left beneath the acromion may be, as far as possible, obliterated.

The method advised by Farabeuf for the adjustment of the wound after Larrey's operation is very excellent. A modified Velpeau dressing or a Desault bandage may be applied. The median part of the wound is united by sutures as usual. The lower extremity is left open, to permit of efficient and simple drainage. The upper portion of the wound is not united by sutures, but the edges of the incision are brought together by a compress. This compress, which is applied on the outer aspect, not only supports the wound, but also forces the integuments under the acromion, and obliterates the hollow about the glenoid fossa. The patient's thorax should be kept raised and the body inclined a little toward the injured side.

INTERSCAPULOTHORACIC AMPUTATION.

After-treatment.—The wound, when closed with sutures, forms an oblique line running from above downward, outward, and backward. A large pocket is left in the stump, in which inflammatory exudations may readily collect. This pocket should be obliterated by pressure, a matter best accomplished by covering the wound with iodoform gauze, over which the pressure of a bandage is brought, or the open method of treatment may be employed. If this is well effected, and if no diseased or damaged tissue has been left behind, a drainage-tube is not required. The patient should be kept well raised up in bed. There is a special risk of pneumonia after this operation.

AMPUTATIONS AT THE HIP-JOINT.

After-treatment.—After the operation all necessary means should be taken to prevent severe shock. The head should be kept low, the body well covered with blankets and kept warm by a hot bottle, and, if necessary, enemas of brandy, or salt solution and whisky or hot coffee may be administered. Intravenous injection of saline solution may be

necessary during or after the operation and strychnin may be given hypodermatically.

By means of a suitable cradle the stump can be left uncovered and the dressings be exposed to the air. The stump should be supported upon a firm pillow or cushion, care being taken that no pressure is exerted upon the wound.

If every care is taken, the great wounds left by these operations will heal throughout by first intention. There is always considerable discharge of serosanguinolent matter from the large wound surface. In the racket operations, and in Guthrie's disarticulation, drainage may be secured by omitting a suture or so at the most dependent point of the wound. In the transfixion operation by anteroposterior flaps a drainage-tube will most probably be required.

As tension sometimes arises from simple extravasation of blood which interferes materially with healing, Senn recommends the introduction of an absorbable capillary drain at the lower angle of the wound. A strand or two of catgut twisted into a cord answers an admirable purpose, affording a sufficient drainage without interference with healing, and requires no change or interference with the dressings.

The first dressing should be voluminous and firmly secured by an elastic bandage forming a figure-of-8 around the pelvis. On its inner and front aspect the dressing should be covered with jaconet or rubber tissue. It is important to defer the changing of these dressings for three or four days if possible, as it may increase the shock. There may be retention of urine, requiring the use of a soft catheter.

The weight of the flaps renders it important that the sutures should not be removed too soon, and after their removal it will, as a rule, be found necessary to support the flaps by strapping.

Care must be taken that the dressings are not soiled by urine or feces, and that bed-sores do not form over the sacrum or the trochanter of the opposite side. As the action of the bowels may soil the dressings, it is best to keep them from acting for four or five days by a small opiate.

Prosthetic Considerations.—The average American surgeon amputates solely on the principle of saving "all that is possible," thus making in the majority of amputations a nearly hopeless case for the prosthetist, and in many instances leaves the crippled patient to the fate of wearing an artificial limb only with great inconvenience and discomfort.

European surgeons are far in advance in this respect, and after

prolonged scientific observation and experiment seem to have grasped the importance of operating from a functional as well as an anatomic standpoint, thus assisting the manufacturer of artificial devices in adding to the future comfort and welfare of their patients.

Of the few American surgeons now in accord with these advanced ideas, Nicholas Senn is one of the most prominent. In a late surgical treatise in his able article on the general technic of amputations he writes as follows:

"In all amputations below the base of the thigh the functional result must be taken into serious consideration in determining upon the site of the operation. Disarticulation at the knee-joint has but few advocates at the present time because the resulting stump is bulbous and ill adapted for the wearing of an artificial limb. In amputations through the upper

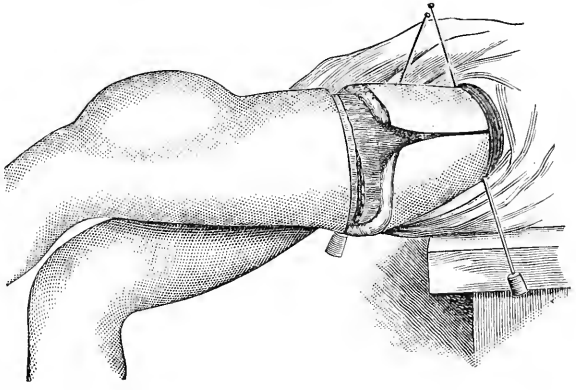

FIG. 109.—WYETH'S AMPUTATION AT HIP.—(*Brewer.*)

part of the leg it must not be forgotten that a stump four inches long is the shortest one that enables the patient to wear an artificial limb. It is such a stump, too, that will be most serviceable in wearing a peg-leg, which, among the poorer classes, is largely depended upon for locomotion. If an amputation has to be done above this level, the next point of selection is through the base of the condyles. For this operation the surgeon should select the Gritti-Stokes' transcondyloid osteoplastic amputation, which yields an ideal conic stump, well fitted for the wearing of an artificial limb." (Senn.)

"Whenever admissible, in all amputations of the lower extremity above the ankle-joint, the operation should be made at a point and in such a manner as to secure a conic stump, so keenly appreciated by every manufacturer of artificial limbs, and subsequently by the patient.

It must be remembered that when the patient comes to wear an artificial limb, the weight of the body should not fall upon the end of the stump, but upon its sides, something that can be fully and satisfactorily accomplished only if the shape of the stump is conic."

"This can be illustrated also by injury or disease of the ankle-joint and tarsus necessitating amputation. The pathologic indications may be fully met by Syme's amputation through the ankle-joint, but the resulting stump would be far less useful to the patient than if the amputation had been made at the point of selection—that is, at the junction of the middle and lower third of the leg." In this connection Fred T. Murphy, after extended inquiry into the subsequent history of amputation cases, says: Partial amputations of the foot or amputations of the ankle-joint, except under unusual conditions, are not as satisfactory as those above the ankle-joint. Tibial stumps between six and eight inches long are the most serviceable. Amputations through the knee-joint are inferior to those just above the condyles. The longer the thigh stump, the better, provided the condyles have been removed. In general, in tibial amputations down to four inches and in thigh amputations down to five inches, sacrifice bone in order to obtain good muscle-flaps.

AMPUTATION OF THE THIGH.

After-treatment.—The thigh should be raised and supported upon a firm pillow or cushion, to which it should be lightly secured. The limb should be placed in the abducted position. The extremity of the stump should project beyond the end of the pillow. It will be thereby exempted from pressure, and drainage will not be interfered with. A supporting splint is not required in these amputations, although it may sometimes be employed with advantage after the circular operation and in amputations through the lower part of the limb.

A few sutures should be omitted at the most dependent angle of the wound, to allow for drainage—or, better still, a short tube and piece of gauze should be inserted at that situation. The oozing during the first twenty-four hours is considerable. In no case should a large drainage-tube be drawn right through the depths of the wound from one extremity of the incision to the other.

As the flaps are large and heavy, the sutures should not be removed too soon. After their removal, the flaps may need to be supported for a while by strapping.

If silk ligatures have been applied to the arteries, no attempt should be made to remove them prior to the fourteenth day, after which date at the time of the daily dressings the ligatures in turn should be gently pulled upon, but no harsh effort should be made to remove them. It frequently happens that silk ligatures will remain quite firmly embedded in the tissues, causing very little disturbance, for weeks or months. Should, however, after several weeks a slight tenderness or sloughing occur, the patient should be anesthetized and the ligatures forcibly removed.

AMPUTATION OF THE FINGERS AND THUMB.

In amputating fingers the flaps should be made so that the cicatrix should come upon the dorsum of the hand with the least possible interference with the palm.

Treatment.—The wounds after these operations as a rule heal well, but are often very painful. As the skin of palmar flaps is usually thick and stiff, the sutures should be well applied, and should not be too soon removed. Silkworm-gut sutures are well adapted for these operations. The hand should be kept elevated, and never allowed to hang down, and care must be taken that too tight bandages are not applied about the wrist.

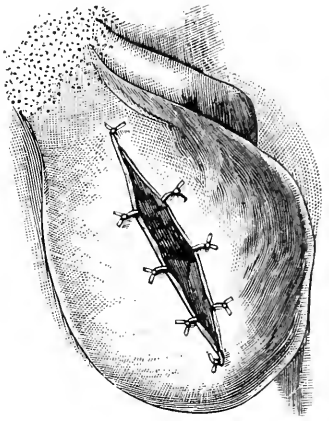

FIG. 110.—OPEN INCISION AND SUTURE OF SAC.—(*Moullin, after v. Volkmann.*)

In the larger operations, especially when a palmar flap has been cut, the hand should be supported upon a splint in order to arrest the movements of the wrist. As a rule, no drainage-tube is required, a small piece of the selvage of iodoform gauze, or a few strands of horsehair or of silkworm-gut, being usually all that is necessary; but when the metacarpus is concerned, and when the tissues of the palm have been lacerated or torn, a small tube may with benefit be introduced and retained for some twenty-four or forty-eight hours. It should be remembered, particularly in dealing with laboring-men, that to conserve every particle of tissue which may be of subsequent use to the patient is the highest art of surgi-

cal treatment. In case fingers have been severed by accident, we are not to sacrifice bone in order merely to secure flaps. By this method

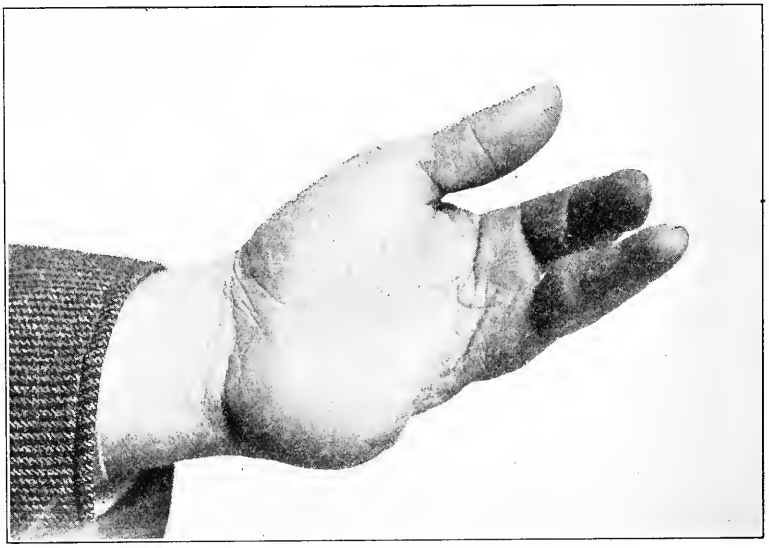

FIG. 111.

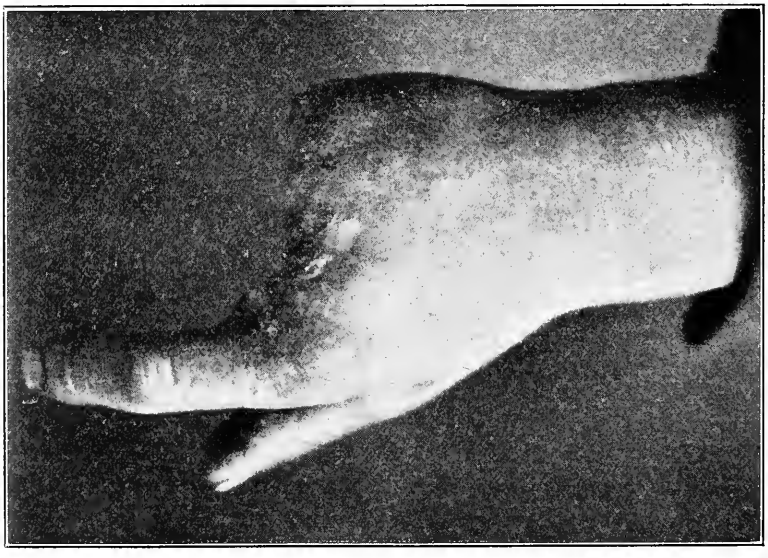

FIG. 112.

healing will take place more slowly, but the additional length of the fingers more than compensates for the delay.

The partial operations following upon crushes of the hand must be treated upon the same principles as apply to complicated or contused wounds.

Figs. 111 and 112 represent postoperative results in cases where the amputation was performed regardless of any fixed rule or special method, and made solely with the view to preserving as much tissue as possible, and forming strong, useful hands.

AMPUTATIONS OF THE TOES OR PORTIONS OF THE FOOT.

Considerations of Asepsis.—It must be confessed that the wounds of these operations do not always heal so kindly as might be expected, and often compare unfavorably with like wounds in the hand. In a few cases this may be due to the fact that the operation is an imperfect one—a mere trimming of a mangled part—and is the outcome of a desire to remove as little tissue as possible.

Fig. 113.—Amputation of Toe.—(*Hare.*)

The less free circulation of the part, and the circumstance that the wound is less conveniently placed for drainage, may serve in other cases to explain the tardier healing when compared with operation wounds of the fingers. There is little doubt, however, that the chief reason lies in imperfect disinfection of the skin before operating. The clefts between the toes are unrivaled breeding-grounds for bacteria. Before an amputation in this region the most sedulous care should be paid to repeated disinfection with alcoholic solution of mercury biniodid or of carbolic acid. If the aseptic precautions are thorough, the wound will probably heal as well here as in any other part of the body.

Removal of Sutures, Drainage, etc.—As the skin of plantar flaps is usually thick and stiff, sutures should be so applied as to retain a good hold of the parts. They should not be removed too soon, as the flap may give way. Silkworm-gut sutures may often be left in for ten or even fourteen days. The smaller amputations require ordinarily no drainage. In operations upon the great toe, a fine tube, or a tube split in halves, or strands of silkworm-gut, or a gauze drain may be retained for the first twenty-four hours. In case of the removal of the

great toe, together with its metatarsal bone, the foot should be allowed to lie a little upon its inner side, provided direct pressure is not made upon the wound. When the fifth toe has been removed in a similar manner, the foot should be inclined toward the opposite side.

Position.—The limb should be kept exposed or outside of the bed-clothes. The leg should lie so that the foot can rest upon one or the other side. When the patient lies flat on the back, the toes point upward, drainage is rendered almost impossible, and every facility is given for the gravitation of the effusions of the wound into the depths of the foot. If the flaps have been carelessly cut, if the tendon-sheaths have been left open, if the wound is not perfectly aseptic, and if the foot is so placed that proper drainage is impossible, it is no matter for wonder that the stump does not do well, and that deep-seated suppuration is detected in the foot.

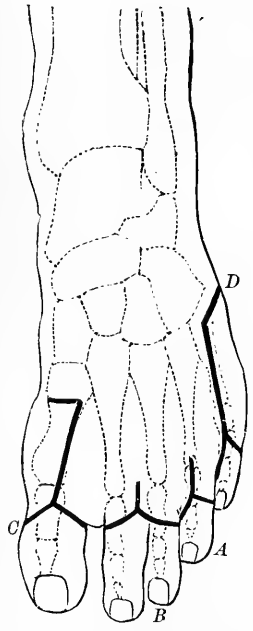

FIG. 114.—LINES OF INCISION FOR AMPUTATION OF TOES AND METATARSAL BONES.—(*Stimson.*)

After Lisfranc's and Hey's amputations the limbs may be allowed to lie upon one or the other side with the knee flexed. The pillow supporting the foot should be firm; the stump may project a little beyond the end of the pillow, and to this support the leg may be lightly secured.

After Chopart's operation and after the sub-astragaloid amputations the stump should be supported upon a back-splint, which is kept a little raised by a firm pillow or cushion. By this means the heel-flap is supported, and the os calcis in the Chopart operation is to a great extent kept from altering its position. The knee should be a little flexed, and the stump may be inclined laterally, so as to favor drainage. The splint employed is an ordinary straight back-splint, suitably padded. A pad is introduced beneath the tendo Achillis. The skin is protected by a piece of guttapercha molded to the limb and lined with lint. The splint is secured by straps and buckles.

Drainage-tubes should not be employed unless actually necessary, and should never be passed right across the angle of the wound, from one extremity of the incision to the other. A small piece of tubing may

be introduced at each of the two corners of the wound—as in Hey's, Lisfranc's, and Chopart's amputations—and sutures at these points may be omitted. In any case the tubes should, under ordinary circumstances, be removed in twenty-four hours.

In the subastragaloid operations, when a heel-flap exists,—with a pouch left by the removal of the os calcis,—a hole may be made through the center of that flap into the pouch, and a short tube introduced. This need not be retained more than one day. When the major flap is formed from the heel or sole, it should be remembered that the tissues of those parts are usually tough and unyielding, and that consequently an undue strain comes upon the sutures. These should be deeply inserted, and should not be removed too soon. In a "Syme" they may often be retained for ten days. After their removal it may be necessary to support the flap with strips of adhesive plaster.

Care must be taken that the pad of the splint does not press unduly upon the extremity of the stump. This splint serves to support the heel-flap, and, in the case of the intracalcaneal amputations, it helps also to keep the osseous surfaces in contact and to restrain the action of the muscles of the calf.

The knee should in all instances be a little flexed, and the stump may, when required, be inclined a little laterally, to favor drainage.

CHAPTER XVII.

EXCISIONS OR RESECTIONS OF JOINTS.

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EXCISIONS OF JOINTS.

The Kocher Method.—The modern method of typical excisions which is most worthy of recommendation seems to us to be the following:

1. To employ as simple an incision as possible (Langenbeck), special care being taken not merely to place it in the intervals between the muscles, ligaments, and tendons, but to carry it down to the bone in such a way that the smallest vessels and nerves can be avoided, and also to place it in the frontier line between the muscles supplied by different nerves.

2. To detach subcortically the capsule, the periosteum, and the ligamentous and tendinous attachments, and to remove all the diseased bone with the articular extremities, should this be deemed necessary in order to obtain a better functional result. If attention be paid to these points with strict aseptic precautions, arthrotomy can be undertaken with benefit in the early and mild stages of joint disease. (Kocher.)

Essentials of After-treatment.—It is obvious that in excisions the limb should be immobolized in a plaster bandage, so that the new articular ends may be kept firmly in contact in good position. Where there is any difficulty in maintaining them in position, it may be necessary to wire the ends together in such a way as to retain them in the desired position without ultimately preventing the proper movement. Lane has made use of this plan with very good result in old-standing affections of the hip-joint. Healing usually occurs rapidly, and if the wound remains aseptic, the patient may begin passive movements in fourteen days in the case of the upper extremity, while in the case of the lower extremity he may be allowed to go about with the limb in plaster. The sooner movement is begun, the better will be the result, even if it is only very slight movement inside a well-padded plaster case. To obtain early restoration of function it is essential to get rid of the sensitiveness of the sawed ends of the bone as soon as possible. Where ankylosis is desired, as in excision of the knee-joint, firm fixation is the

best means of obtaining this object, the limb being placed at once in a plaster cast. To obtain firm union, the bones must fit accurately together, or they may be wired or nailed together. To obtain, rapidly, comparative insensitiveness in the ends of the bone in case a movable joint is aimed at, Kocher adopts the following procedure, which he terms "the dislocation or secondary reposition method": "In the elbow and hip, for example, after resecting the ends of the bones we bring them into a dislocated position, so that the sensitive sawed ends of the bones are merely in contact with the soft parts; after ten to fourteen days, when the skin-incision is quite healed, they can be easily placed in proper position. The patient then begins at once to move the limb, which by

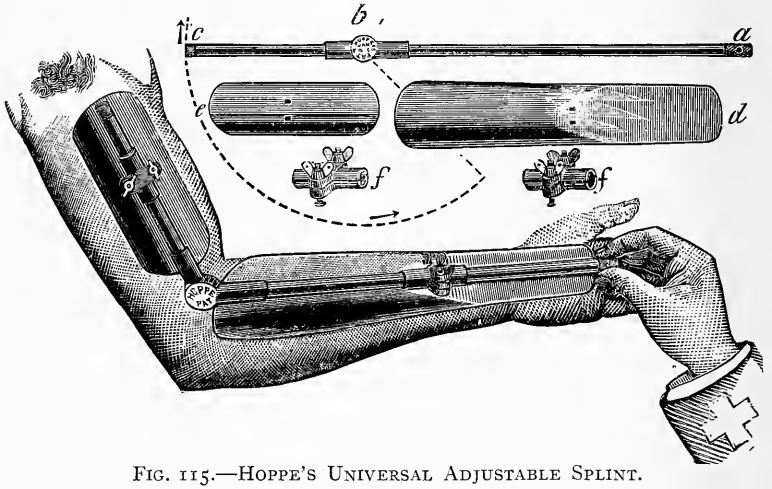

FIG. 115.—HOPPE'S UNIVERSAL ADJUSTABLE SPLINT.

a, b, c. Steel or aluminum connecting rod; movable joint at *b*; *d* forearm splint; *e* arm splint; *f* thumb-set caps or screws.

the usual method he is quite unable to do, however much he may desire to. It is essential, too, that the movements of the muscles should be begun early, if the function of the joint is to be restored quickly. By means of an apparatus provided with the means of elastic flexion and extension, while the axis of movement is maintained, the treatment is greatly assisted."

Excision of the Shoulder-joint.—In excising the shoulder-joint it is very important to remove as little of the bone as possible, for the reason that it is necessary to leave the attachment of the rotator muscles intact if this can be safely done; this permits rotation of the arm, whereas after the old operation, in which the rotators were completely cut across

and the bone was sawed on a level with the surgical neck, the resulting limb was very useless. Before the wound is closed with stitches it is advisable to insert a drainage-tube at the lower angle of the wound for a few days, as a considerable cavity is left which may become distended with blood and serum. The tube is usually removed about the third day. After the usual gauze dressings have been applied, a large wedge-shaped pad is placed in the axilla to prevent displacement inward of the upper end of the humerus. It is well also to place a firm pad over the front of the joint, because the upper end of the bone is apt also to be drawn forward. The wedge-shaped pad should extend as far down as the elbow, and the forearm should be flexed and supported by a splint. The hand should not be bound to the side.

After-treatment (Cheyne-Burchard, "Manual of Surgical Treatment").—So soon as the wound is healed the arm may be fixed in proper position by a starch or plaster bandage, and after two weeks, passive movements should be begun; the period at which the passive movement should be employed depends largely upon the healing of the incision and the amount of bone removed. If the whole of the upper end of the humerus has been removed and the rotators divided, the elbow should be supported and the arm fixed for four or five weeks, as otherwise a very lax joint is likely to result. If, on the other hand, the operation we have described is sufficient, passive movement should be begun after the fourteenth day. Special attention must be paid to preserving rotation, which is the movement most likely to be lost; abduction should also be carefully attended to. The axillary pad and the wrist-sling should be continued for six or eight weeks.

Sir Frederick Treves suggests the following: The upper end of the humerus is to be brought into contact with the glenoid fossa. The arm is secured to the side, the hand rests in a sling. A large pad of cotton-wool is introduced into the axilla. This pad is intended to support the bone, to assist in fixing the parts, and to counteract the tendency which will be exhibited for the upper end of the humerus to be drawn inward under the coracoid process. This displacement is especially apt to occur when the external rotator muscles have been divided, and there is little to withstand the action of the pectoralis major and latissimus dorsi. The size of the pad must be regulated according to the needs of the case. It should be of triangular outline, with the base uppermost. The pad is likely to fail, if it fail at all, from being too small rather than too large. No splint is required.

Passive movements of the fingers, wrist, and elbow may be commenced within a day or two after the operation. Very gentle passive movements of the shoulder may be first attempted at the end of some fourteen days. These movements should consist of flexion and extension, of slight rotation, and of still slighter abduction. The latter position tends to throw the end of the bone inward—or, rather, to assist the disposition to that deviation. Massage, electricity, and active movements will follow in due course. The arm may be allowed to hang, with no other support than a sling, at the end of four or five weeks.

Results.—The results of this operation are very satisfactory. The mortality of the operation is slight. More than two-thirds of the subjects of the operation recover, with quite useful limbs. In many instances the restoration of function has been remarkable. As a rule, flexion and extension are freely performed, and the patient can lift considerable weight. Adduction also is well accomplished. On the other hand, rotation movements and abduction are feebly performed. The arm cannot be lifted beyond a right angle with the trunk. It is after the subperiosteal operations that the best results have been obtained. There is a tendency, as already stated, for the upper end of the bone to assume the position occupied by the head in subcoracoid dislocation. Ankylosis appears to result more frequently than a flail-like joint.

Excision of Elbow.—After-treatment.—Treves states that after the operation the limb must be placed upon a suitable splint and the bones so adjusted that the greater diameters of the bony surfaces correspond and do not cross. The hand should be in the mid-position between pronation and supination, and the elbow be very slightly bent —so slightly that the forearm will be nearer to the extended posture than to the position it occupies when at right angles to the arm. The precise angle recommended by most surgeons is an angle of 135 degrees.

Very many forms of splint have been devised. The main requirements of such appliances are that they may be light, strong, rigid, easily kept clean, and do not interfere with the drainage and dressing of the wound. In many cases a splint may be dispensed with, the support of the dressings and a pillow being sufficient.

Hausmann's combined splint for excision of the wrist or elbow answers its purpose well, and also permits the joint to be exercised without the splint being removed. The fingers should be free. The splint and limb may be at first suspended from a cradle, or supported upon a pillow with sand-bags.

It must be borne in mind that there is some disposition for the bones of the forearm to be displaced backward, that too wide a distance between the bones may lead to a flail-like joint, and that if, on the other hand, the sawed surfaces be kept in close contact, in young subjects bony ankylosis may ensue. The relative position of the bones can always be estimated by a skiagram.

In general terms, it may be said that to insure a false joint the bones should be separated for the distance of half an inch. After a successful excision by the subperiosteal method in healthy subjects the disposition to ankylosis is considerable. As ankylosis is especially to be feared in children, the limb may be put up from the first on a right-angle splint, such as that recommended for the purpose by Jacobson, with a movable or adjustable joint at the elbow. When also a considerable quantity of bone has been removed, the use from the commencement of a rectangular splint is advised by many.

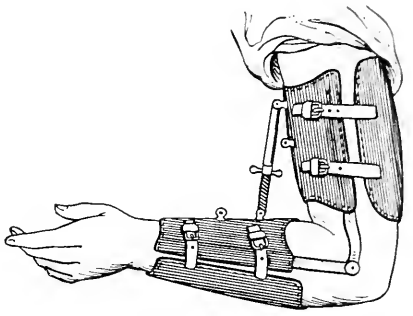

FIG. 116.—ELBOW SPLINT.—(*Strohmeyer.*)

Passive movements of the fingers and shoulder, and flexion and extension of the wrist, should be commenced as soon as possible after the operation—possibly by the third day—and should be continued daily. Passive movements of the elbow may commence about the tenth day, provided that the healing process has proceeded favorably and the measure can be borne by the patient without undue pain. In children such movements may at first be required to be carried out under an anesthetic. When four or five weeks have elapsed, the forearm may be gradually brought up until it forms a right angle to the arm. At the end of six or eight weeks the splint may be dispensed with, and the movements of the elbow should be free. Active movements, aided by massage and galvanism, should now be advised; and within four months from the time of the operation the new joint should have acquired solidity and be capable of exhibiting a free and extensive range of movement.

Excision of the elbow has led, on the whole, to very satisfactory results, and in a large proportion of the more favorable cases the results

have been most admirable. Even if ankylosis occurs at a right angle, the limb is in a better condition than it was while diseased. In the more unfortunate instances repair is imperfect for various reasons, and a very loose false joint, resulting in a flail-like limb, is the final production. Even in such a case a good deal may be done by means of a suitable splint; the apparatus shown in Fig. 116 has proved most efficient. It consists of two pieces, one of which grasps the upper arm and the other the forearm, the two being connected by a metal band over each side of the elbow, jointed to permit of flexion and extension. This apparatus prevents lateral mobility, and, if worn for some months, it is quite possible that a joint which was at first very lax may finally be quite satisfactory.

RESECTIONS OF JOINTS.

Resection of the Wrist-joint.—After resection of the wrist-joint the wrist should be dressed as nearly straight as possible, Esmarch's

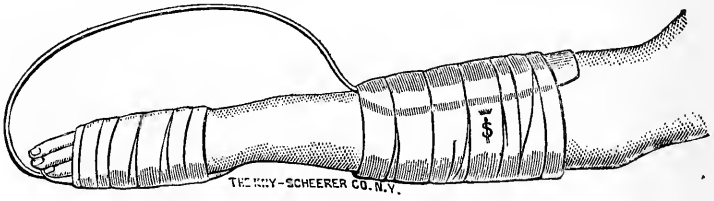

Fig. 117.

interrupted splint (Fig. 117) being applied. The results of this operation vary very much, and on the whole are not satisfactory. The splint

Fig. 118.—Proper Method of Applying Bandage After Operations on Forearm, Wrist, or Hand.

must be worn for a very considerable time,—three to six months,—and there is a tendency for the hand to fall into a position of adduction.

Passive movement of the fingers is begun on the second day, whether the inflammation has subsided or not, and continued daily. Each joint should be flexed and extended to the fullest extent possible in health, the metacarpal bone being held quite steady to avoid disturbing the wrist. By this means the suppleness gained by breaking down the adhesions under chloroform is maintained.

Pronation and supination, flexion and extension, abduction and adduction, must be gradually encouraged as the new wrist acquires

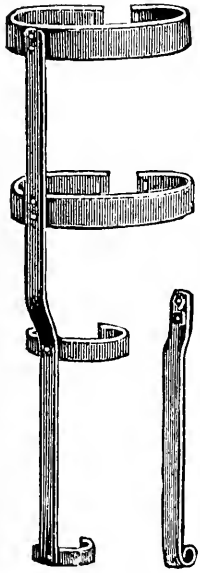

FIG. 119.—THOMAS'S HIP SPLINT.

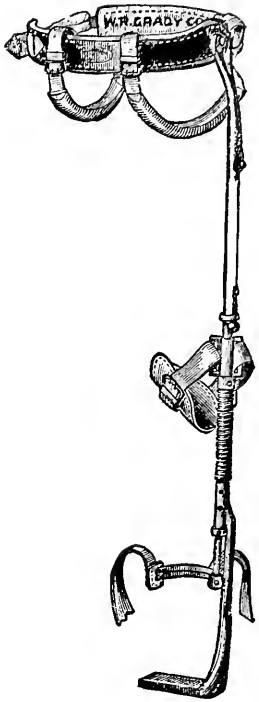

FIG. 120.—SCHAFFER'S HIP SPLINT.

firmness. When the hand has acquired sufficient strength, freer play for the fingers should be allowed by cutting off all the splint beyond the knuckles. Even after the hand is healed, a leather support should be worn for some time, accurately molded to the front of the limb, reaching from the middle of the forearm to the knuckles, and sufficiently turned up at the ulnar side. This is retained *in situ* by lacing over the back of the forearm.

Resection of Hip.—GENERAL CONSIDERATIONS.—After the ex-

cision and arthrectomy have been completed, the hemorrhage carefully arrested, and the acetabulum thoroughly cleaned with a sharp spoon, the trochanter is replaced and fixed in position with an aseptic bone or ivory nail, aided by sutures of catgut embracing the periosteum and the dense fascia. In a number of cases Senn has relied on suturing with catgut exclusively in immobilizing the trochanter, and had the satisfaction of observing that the trochanter was perfectly held in place until bony union was sufficiently firm to dispense with direct means of fixation. The acetabulum is drained with a tubular drain and iodoform gauze, which are brought out through a separate opening behind the resection wound. The dressing must be large, embracing the upper half of the thigh and the same side of the pelvis as far as the crest of the ilium. As a primary immobilization dressing a long external splint with footboard and extension by weight or straps will be most comfortable and efficient (Fig. 119 and Fig. 120). So soon as the patient is able to leave his bed, a plaster-of-paris dressing is relied upon in securing fixation and in guarding against undue shortening.

Hueter's anterior incision for resection is now rarely employed except for exposing the acetabulum in congenital dislocation of the hip or in operations upon children. The posterior incision gives much more room and admits of better drainage, and is now universally adopted as giving better results.

After-treatment.—When the patient is placed in bed, extension should be employed, a weight of three or four pounds being used for a child, the limb being in the abducted position, all motion and rotation being prevented by a properly adjusted splint (see Fig. 90). A Liston's long splint is very frequently used, and applied to the sound side from the axilla to beyond the toes, so as to prevent any flexion of the hip-joint. The patient should be laid upon a mattress divided in three parts in order that the central portion may be removed for nursing purposes without necessitating any disturbance.

The extension and fixation of the limb should be kept up for about six weeks; at the end of that time a Thomas's hip splint (see page 395) may be employed. This should be bent well outward opposite the joint so as to keep the limb in the abducted position; the splint should be provided with a pelvic band. In quite young children, who are very difficult to keep quiet, either a double Thomas's splint well padded or a simple Phelps's box splint will be better than the single splint. Contrary to the common recommendation, we very strongly advise that

the patient should not be allowed to walk or to bear any weight on the limb for several months—at least six or eight after the operation, when the patient may be placed in an ambulatory splint. If this be done, the consolidation of the structures in the neighborhood of the joint will

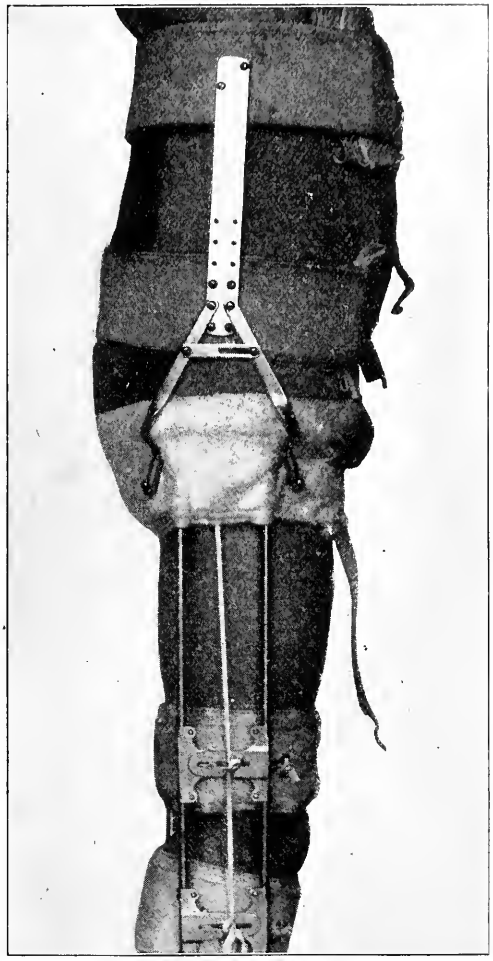

FIG. 121.—AMBULATORY SPLINT.

give a much firmer joint than is otherwise obtainable. It is very seldom that anything like bony ankylosis occurs, but if a movable joint be desired, this may be assured by performing passive movement of the hip through a limited range twice a week after the wound has healed. The

patient need not be kept in bed longer than the third or fourth week. He may be allowed to get about on crutches with an ambulatory splint, or a high boot on the sound foot so as to avoid any risk of the affected foot being put to the ground.

When excision is employed in the later stage of the disease, where the disease has been cured and the operation is only done for the deformity, mere removal of the head of the bone is all that is necessary; the removal of the capsule is not called for, as the disease has disappeared. The object of the operation in these cases is simply to get rid of the head of the bone so as to obtain a movable joint.

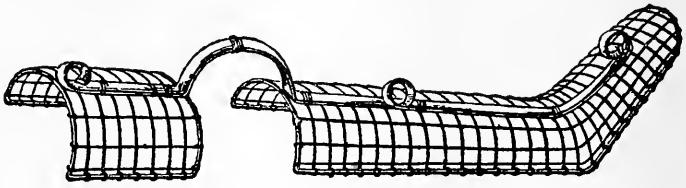

FIG. 122.—ANTERIOR LEG SPLINT, FOR RESECTION OF THE KNEE-JOINT, FITTING EITHER SIDE.

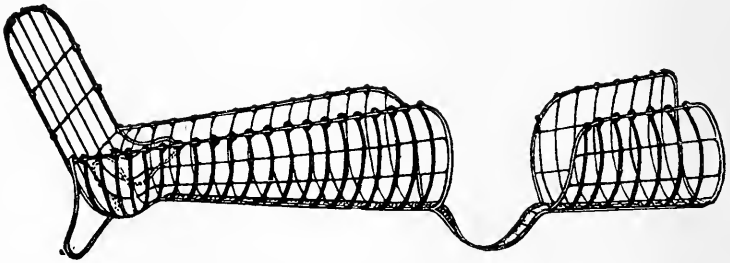

FIG. 123.—POSTERIOR LEG AND THIGH SPLINT, FOR RESECTION OF THE KNEE-JOINT, FITTING EITHER SIDE.

If sepsis occurs, the after-treatment is tedious and uncertain, and frequently demands considerable mechanical skill in the application of splints, and at the same time permit surgical dressings to be applied when the wound is suppurating. The open-wound method of treatment is always preferable, and the after-treatment does not vary from methods already described under the head of "Treatment of Septic Wounds." In these prolonged cases the ambulatory splint (Fig. 121) not only assists in the radical cure, but renders the patient more comfortable and permits him to be up and around.

Excision or Resection of the Knee-joint.—THE AFTER-TREATMENT is of the utmost importance, is tedious, and often surrounded

with difficulties. There is a tendency to displacement, and notably to a displacement of the tibia backward. If sound healing does not take place, the limb is worse than useless, and the flail-like limb that may result is of less service to the patient than a good artificial leg.

The limb must be put up perfectly straight,—*i. e.*, in the position of complete extension,—and for the purpose of fixing it many surgeons employ plaster-of-paris. The rigid dressing formed of this material is not entirely satisfactory. It may exercise an unequal pressure upon the parts, and may lead to edema, etc. Discharge may find its way between the splint and the limb, the dressing is difficult to remove, and even when large "windows" are provided the inspection of the part can never be so complete as it should be (Fig. 91).

A splint should be provided which will allow the bones to be kept in good position, will permit free inspection and examination of the wound, and will not interfere with dressing and drainage should drainage be necessary.

The ordinary posterior leg-and-thigh wire splint (Figs. 122, 123) for resection of the knee-joint is quite popular with some surgeons, but the wire when the heel touches should be removed, cut or bent out to avoid pressure. It is retained and held in place by gypsum bandages to immobolize the part above and below the knee. The knee itself is dressed and so protected that it can be examined without disturbing the other dressings. It is well that the splint should be suspended. Marsh points out that "the plan of firmly bandaging the lower end of the femur to the back-splint leads to great swelling about the wound, and materially retards repair. It is apt also to induce persistent venous oozing after the operation." To avoid these drawbacks, he employs Gant's splint. This simple splint, instead of binding the femur down to the level of the tibia, brings the tibia up to the level of the femur, and no tight bandaging is called for.

A splint which answers admirably in the after-treatment of excision of the knee is Hodgens' suspension splint (Fig. 124).

Quite a number of the splints employed have the disadvantage of being complex and difficult to adjust. Dry dressings should be applied to the wound and should not be changed oftener than is absolutely necessary. If silver wires are used to maintain the bones in apposition, they are allowed to remain, but if nails have been used, they should be removed at the end of the third week. The dressings should not be changed, as a rule, except to remove the drainage-tube. The limb

must be kept upon the splint until it is sound. This period will vary from six weeks to three months. Complete recovery can usually not be expected until six months have elapsed.

After the splint has been removed, a light leather support, strengthened with a strip of steel at the back, should be applied; and in the case of children the support must be worn for two or three years. A thick-soled boot will be required to meet the inevitable shortening, which, however, in the most favorable cases, does not amount to more than about an inch.

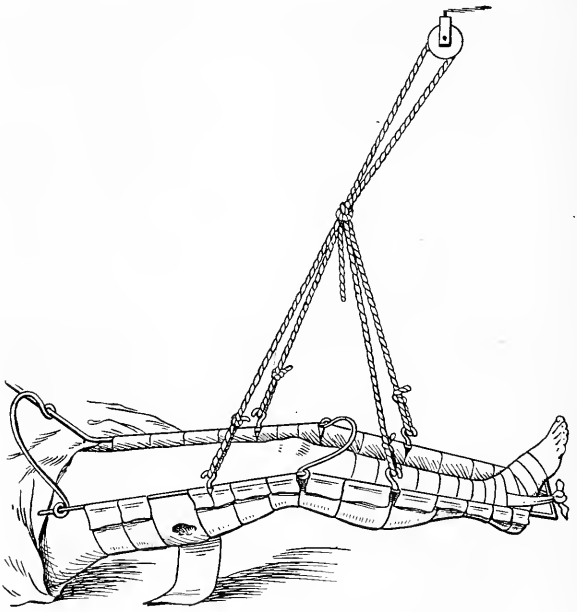

FIG. 124.

EXCISION OF KNEE-JOINT (CHEYNE'S METHOD).—The bleeding is arrested and the wound stitched up, but before doing so it is well to wire the femur to the tibia; this is not absolutely essential, but it keeps the limb in position while the dressings are being applied, and it serves to prevent any antero-posterior dislocation of the bone surfaces. It must be remembered that the divided surface of the tibia is much broader than that of the femur, and if, therefore, the anterior margins of the two bones be brought into apposition, the posterior surface of the tibia will project markedly into the popliteal space, and when the limb is

placed upon the splint, pressure may be exerted upon the popliteal artery, and gangrene of the limb may result. The posterior margins of the bones should therefore be accurately adjusted, and it is with the view of securing this that fixation of the bones is advisable. Some trouble may, however, be caused from the extreme softness of the bone, which allows the wires or pegs to cut through considerably, and, therefore, great care must be taken to keep the limb in proper position after the wire has been introduced.

As a rule, it is well to introduce a drainage-tube at the outer edge of the incision, the rest of which is sewed up by a continuous suture; the limb is placed upon a Thomas knee splint (Fig. 123).

After-treatment.—When a drainage-tube has been used, the dressing must be changed in three days, at which time the tube may be removed. When changing the dressing it is well to have a fresh splint prepared in a manner similar to the original. The splint is then opened and the front of the knee dressed; while this is being done, an assistant must fix the thigh to prevent starting of the limb, while another similarly fixes the leg. It is well, in fact, at the first dressing to keep the limb in firm contact with the splint by opening one side at a time while the limb is pressed against the other, and one side is washed and dressed at a time. The splint is elevated, the inclined plane or pillow upon which it is resting is removed, and then the splint is opened. One assistant grasps the thigh and another the leg, while the surgeon grasps the limb on either side of the knee; the splint is then allowed to drop away from the limb, the posterior part of which is thoroughly washed with a 5 percent carbolic acid solution and afterward with a 1 : 1000 mercuric chlorid solution. The fresh splint, with the dressing already arranged, is put in place beneath the limb and gradually raised until the surgeon and the assistants can remove their hands and leave the limb lying upon the fresh splint. The strips of gauze are then wrapped around the knee and the dressing, and the splint is bandaged on.

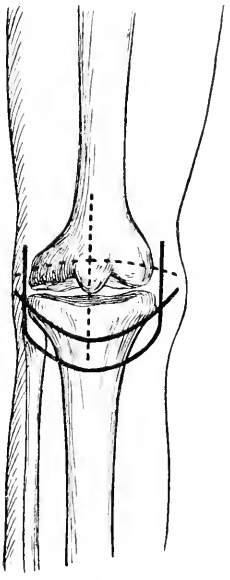

Fig. 125.

It is well at this dressing to impregnate the outside bandage with a starch solution, so as to prevent it stretching and to insure that the apparatus will keep firm for six weeks or so, at the end of which time it may be taken off, the stitches removed, and the limb put up in plaster-of-paris or some similar immovable apparatus.

In three months after the operation union is usually firm enough for the patient to get about without any apparatus. Massage may be required for two or three weeks afterward to restore the circulation and improve the nutrition of the muscles.

Excision of Ankle-joint.—Excision of the ankle is now seldom performed, as it nearly always results in bony ankylosis. Arthrectomy of the joint with removal of the astragalus is far more satisfactory and leaves the patient with a more useful limb.

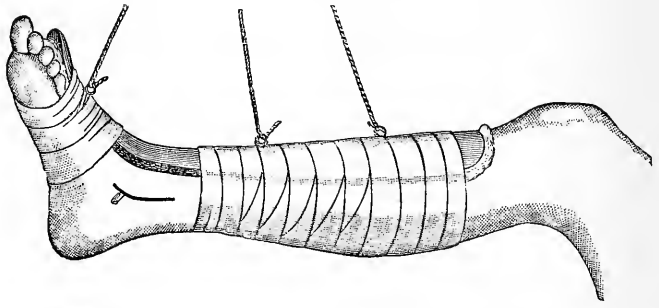

FIG. 126.—VOLKMANN'S DORSAL SPLINT FOR EXCISION OF THE ANKLE.—(*Da Costa.*)

AFTER-TREATMENT for the operation is as follows: The dressings should be changed in a fortnight, when the wound should be healed, and the stitches may be removed. The limb may now be put up in plaster-of-paris, taking care to keep the foot strictly in its normal position. The plaster casing should be maintained for about six weeks, when it should be renewed. The patient should not be allowed to walk until six or eight months have elapsed from the time of the operation.

The chief trouble after arthrectomy of the ankle is the tendency to lateral deviation of the foot,—more particularly inversion,—and this must be carefully guarded against by the use of apparatus until the parts have become quite firm. Afterward the patient must wear a suitable boot designed to prevent lateral displacement. There is no fear of the mobility of the limb becoming impaired, even though the joint be kept in plaster for six months, because the os calcis does not unite firmly to the tibia and a very excellent movable joint results.

RESULTS OF EXCISION OPERATIONS.

The advantages claimed for the subperiosteal method are the following:

(*a*) The periosteum being preserved, new bone is formed to replace that which has been removed.

(*b*) The capsule of the joint is preserved, and the connections of the ligaments are not severed; the new articulation is therefore likely to be all the stronger.

(*c*) The connections of the tendons with the periosteum are not disturbed, and greater muscular strength is consequently given to the new joint.

(*d*) There is much less hemorrhage, the chief area of the operation being subperiosteal.

(*e*) Planes of connective tissue are not opened up, and the cavity left after the removal of the bones is limited and circumscribed by the capsuloperiosteal sheath.

With regard to these claims, there is no doubt that, in favorable circumstances, a large quantity of new bone is produced to make good that lost by the operation. The importance of the periosteum in this connection would appear to be paramount, although some recent writers have adduced evidence in support of the view that the bone-forming functions of the periosteum have been overestimated.

In the most successful cases it cannot be said that the articular ends of the bone are reproduced, and that the new joint is a reproduction of the old. New bone is formed, and fills, in part, the periosteal cavity, and by the periosteum it is limited and molded. The new bone is, as it were, poured into a mold. The amount produced varies. In some instances no new bone is produced, even when a considerable portion of the periosteum is saved; in other cases an excessive amount is found to have been formed; in a few examples the reproduction of the details of the lost bones has been precise and remarkable. In all circumstances it would appear that the new bone is a little unstable, and that it is liable to undergo a certain but varying amount of resorption.

The value of the new bone so produced cannot be overestimated when the results of operations come to be compared, and the main advantage of the subperiosteal method may be considered to be based upon this feature. The preservation of ligaments and tendinous connections is another advantage of this method—an advantage that is substantial and definite.

The disadvantages of the subperiosteal operation cannot, on the other hand, be overlooked. The measure is admirable in theory, but it does not always assume so immaculate a position in practice. In the first place, the operation is often impossible. The detachment of the periosteum is difficult and tedious. In traumatic cases, in adults, the surgeon will find in practice that the strict carrying out of the method of Ollier is barely possible.

The operator who blindly persists in following this method will often find that, after much valuable time has been exhausted, he has bared the bone of periosteum, but has left that membrane in shreds and holes. In young subjects the periosteum is thicker, more active, more substantial, and more easily stripped off. It may also be said that it is more precious, and is in more need of being preserved.

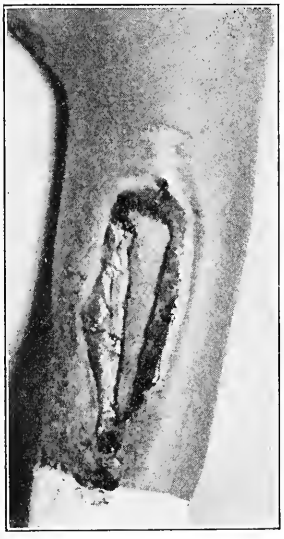

FIG. 127.—BONE DENUDED OF PERIOSTEUM RESULT OF CHRONIC INFLAMMATION.

In cases attended by chronic inflammation the periosteum is generally very easily detached, but in such a condition it is often of doubtful value. It may be infiltrated with inflammatory or tuberculous material, may hinder the healing of the wound, and may even maintain suppuration. But if it lack these potentialities for evil, it may possess no bone-producing property.

In the next place, the subperiosteal operation involves a considerable period of time in the performance, and the shock following the procedure may be considerable. In this respect it compares unfavorably with an excision by the open method, where the actual steps of the operation are simple and the process quick.

The open method, practised as it was in the earlier days of surgery, when ligaments and tendons were divided without scruple, may be safely regarded as a matter of the past; but such a modification of this method as the subperiosteal procedure suggests is of great value.

Summary.—So far as excisions of joints are concerned, the conditions that may be considered under this heading are very numerous and can only be dealt with in outline. They concern not only those general circumstances that influence the healing of wound and the re-

covery of patients after operation, but embrace certain local features that are more or less obvious.

The success of the operation will depend upon the age of the patient, upon his condition, upon his powers of exhibiting repair from extensive wounds, and upon the general circumstances that affect primary healing. His nervous condition is a matter of importance, as is also his capacity for submitting to tedious and often painful after-treatment. The question of perfect asepsis needs but to be mentioned. So far as the operation is concerned, much will depend upon the state of the tissues, upon the nature of the disease, upon the amount of bone removed, upon the complete elimination of the morbid structures, and upon the safety of important tissues in the vicinity of the operation.

Few operations can be cited in which the after-treatment is more important, and in which it has a greater influence upon the success of the case. However well the excision may have been carried out, and however favorable the case may be, the whole complexion may be altered and transformed by neglect in the after-treatment.

The wound must be kept aseptic, and in general terms it may be said that dry and infrequent dressings should be mainly relied upon. The splint must be selected with care, and must be applied with precision. The principal features in the after-treatment are identical with those attending the care of compound fractures.

The position of the limb must be accurately prescribed. If ankylosis is wished for, the bones must be brought into close contact, and must be kept in very rigid relation to one another. If it be intended that a movable articulation shall result, then the approximation of the bones should be less close. No rule can be given that will render definite the precise degree of separation of parts that is desirable after the operation. The approximation will be less close in adults than in young subjects, and in cases in which much periosteum has been preserved than in those where much has been lost. It may be that a week or so will have to elapse before the surgeon can satisfy himself that the adjustment of the sawed ends of the bones is the best that can be attained.

Skiagraphy is very useful in determining the treatment of excision. In some instances, notably those associated with existing deformity of the joint, it may not be wise to enforce the ideal position at once, but the limb will have to be brought gradually into the desired attitude.

When mobility is desired, passive motion will have to be under-

taken. This may be commenced so soon as the inflammatory symptoms have subsided, and so soon as the sensitiveness of the part has become less acute. In most cases this will be represented by a period varying from one to three weeks. Passive motion should not be begun until the operation wound has soundly healed. The treatment of the general health, the duration of the treatment by apparatus, and the employment of massage and electricity will depend upon general principles.

CHAPTER XVIII.

OSTEOMYELITIS, OPERATIONS FOR CLUB-FOOT, OSTEOTOMY FOR GENU VALGUM, ETC.

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OSTEOMYELITIS, OPERATIONS FOR CLUB-FOOT, OSTEOTOMY FOR GENU VALGUM, ETC.

OSTEOMYELITIS.

New Method of Postoperative Treatment of Chronic Osteomyelitis.—(Abstract from article by Dr. E. H. Nichols, Boston, Mass., "Am. Med. Jour.")

The operation consists of an incision through skin and ossified periosteum down to necrotic shaft, reflection of the periosteum, removal of the shaft, either entire or partial, folding of the plastic periosteum in such a way as to approximate the internal layers, suture of the edges by absorbable sutures, suture of the soft tissues, with, in both cases, provision for moderate drainage and complete immobilization. After removal of the necrotic shaft well-marked ossification of the new periosteal shaft appears between the twentieth and fortieth days, and the shaft is solid enough for use in locomotion in from four to eight months. If the epiphyseal line is extensively destroyed, considerable shortening of the limb may result.

This is the operation of preference, and is especially applicable when an accessory bone which can act as a splint is present. The best time for the operation ordinarily is about two months after complete drainage of the acute infection.

The anatomic, functional, and cosmetic results obtained by this operation are much superior to those obtained in any other way in cases of large bony defects due to acute infection of bone.

The chief difficulty in completing the restoration of the shaft is to obtain complete union of the regenerated shaft to the epiphyseal line or to the portion of the normal shaft that remains. Slight necrosis and suppuration may persist at this point after the repair otherwise is complete, and may demand minor operations to remove small fragments of necrotic bone. Union at these points may be delayed, but ultimately always has taken place. When no accessory splint is present, it may be impossible, in special cases, to maintain the contour of the

affected bone by the above-mentioned method. In such cases advantage can be taken of the power of central growth possessed by the shell of periosteal bone in its early stages. This means that the necrotic bone must be removed just as soon as the periosteal shell is sufficiently advanced and solid to maintain contour and bear the weight of the limb. Roughly, this stage is reached when the thickness of the periosteal shell is equal to one-fourth of the diameter of the original shaft. The time

FIG. 128.—RECOVERY AFTER PARTIAL RESECTION OF HUMERUS.—(*Nichols.*)

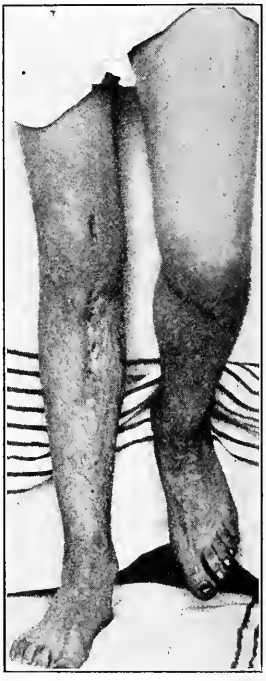

FIG. 129.—RECOVERY FROM CHRONIC OSTEOMYELITIS.—(*Nichols.*)

when this condition exists can be determined by Röntgen-ray examination and by palpation.

If the necrotic shaft is removed at this time, it leaves a solid cylinder of periosteal bone, very vascular, but partly calcified, analogous to the bone seen in an early external callus, and this shell has sufficient power of central growth to fill up large cavities. The rate of central growth seems to be markedly slower than that of peripheral growth. Persistence of sinuses is longer than in the preceding method, partly from a

failure to remove small fragments of necrotic bone at the time of operation.

Finally, the most satisfactory results in treatment of acute osteomyelitis can be obtained by complete drainage of soft tissues and marrow in the acute stage, with the removal of extensive necroses, if they occur, at a secondary operation undertaken about two months later, and by adaptation of the regenerative power of the periosteum for the formation of a new shaft.

After-treatment.—Certain precautions and difficulties in the operation and after-treatment should be considered. Of course, some infection and suppuration will be present when the operation is done, but they should be minimized as far as possible. For this purpose free incisions, followed by careful daily dressing and irrigation, should be provided for some time before removal of the shaft when necessary. Often the reaction to the inflammatory process in the soft tissues and periosteum leads to the formation of an enormous amount of vascular granulation tissue in the soft parts about the bone. Incision of such parts may lead to great oozing hemorrhage during the operation, sufficient at times to make the operation dangerous from loss of blood. This may be avoided by the application of an Esmarch bandage before the operation and removal after the dressing. I have known of two cases where the hemorrhage was so severe as to require that the operation be done in two steps: at the first step periosteum was partly peeled back from the bone and the operation completed some days later after hemorrhage had ceased.

In regard to closing the wound, it is to be remembered that the operation practically never is done on perfectly aseptic tissues. Some suppuration may take place between the approximated surfaces of periosteum, and some is sure to take place between the soft tissue edges. Consequently it is advisable to leave the stitches in the periosteum as far apart as is possible with accurate approximation of the edges. The edges of the soft tissue may be closely approximated, but provision for drainage should be made by very small gauze wicks or catgut drains.

The operation produces moderate depression, not so severe as an amputation. In spite of all precautions there is likely to be some evidence of septic absorption, which makes its appearance on the second or third day, but usually disappearing within a week. In two cases the post-operative infection was sufficient to cause mild delirium for several days.

The wound may heal by first intention over the greater portion, but

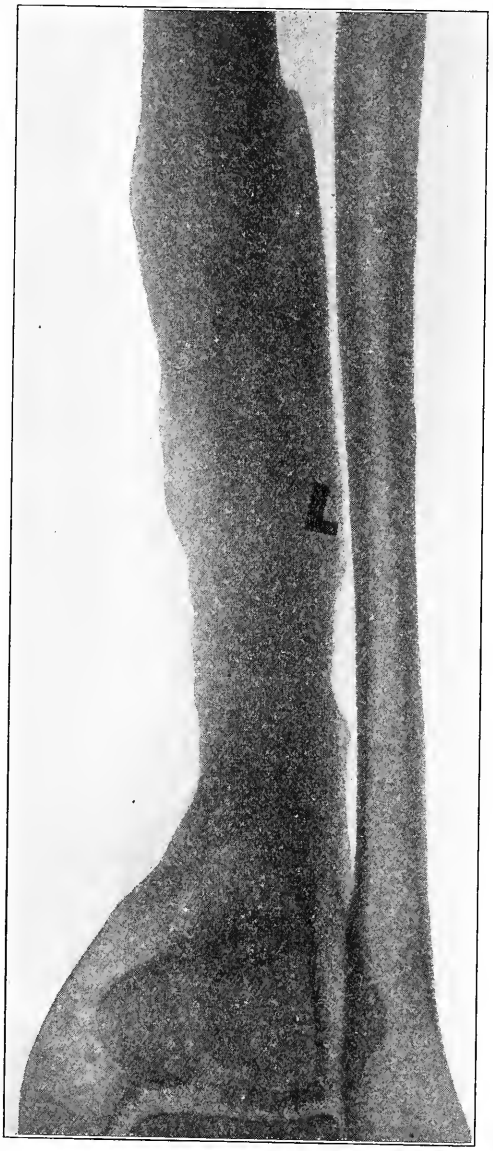

FIG. 130.—MARKED INDURATION OF TIBIA.—(*Nichols.*)

some redness and slight sloughing of the edges may appear. In one

case this sloughing was sufficient to cause considerable gaping both of soft tissue and periosteum. Sinuses often develop for a time, but have always ultimately disappeared. They usually appear near the epiphysis, or at the junction of periosteum and shaft. As has been said, sometimes a slight amount of curcting may be necessary before permanent closure takes place. It is desirable to prevent retention of infected material because of danger to the epiphysis and ultimate infection of the joint.

The first dressing should be changed by the third day. After that time, dressings should be replaced sufficiently often to absorb any discharge; a wet dressing may be necessary for the first ten days.

Marked induration along the line of the bone is frequently felt by the third week (Fig. 130.) From that time on the bone gradually increases in density and size. The new shaft at first and for some months has no marrow canal, but is composed entirely of trabeculæ from periosteal bone with granulation tissue, instead of fat-marrow. The new shaft grows to be larger than the original shaft during the early months, but in time decreases in size and practically comes to the size of the corresponding shaft. In course of time a marrow canal appears in the new bone, to judge from the Röntgen-ray pictures. As a rule, the new shaft is a trifle more irregular than the original shaft. The shaft is strong enough to allow free use after from five to eight months. Even when the entire diaphysis has been removed, if the epiphyseal line has not been interfered with, no shortening of the limb need result, and that, too, in young adults of fourteen years. As far as function and use go, the results often are absolutely perfect. Even in cases in which the epiphysis is interfered with, the shortening may be slight and the function perfect.

CLUB-FOOT.

As to Bandaging.—When a deformed foot has been corrected surgically, the first stage only of the treatment may be said to have been accomplished. The foot must then be fixed by plaster bandages in an overcorrected position. It is first evenly covered with a layer of cotton, and a broad bandage of canton flannel, after which the plaster bandages are applied from the tips of the toes to the upper part of the thigh. It is important that the toes should not project beyond the bandage, because of the swelling that sometimes follows. It is important, also, that the foot should be held in the proper position while the bandage

is hardening, and that it should not be manipulated to any extent after the bandage is applied, in order that no rigid wrinkle may press against the skin. The bandage is carried above the knee in order that the tibia may be rotated outward to its normal position and held there, and because more effective fixation can be assured and greater pressure exerted on the foot in walking. To utilize this pressure to better advantage the bandage should be made very thick beneath the sole, and a thin foot-plate of wood should be incorporated in the plaster. When the bandage is applied, the position of the foot should be that of overcorrection of deformity, flexed beyond a right angle, twisted far outward, and the outer border should be elevated considerably beyond the level of the inner border.

FIG. 131.—ATTITUDE OF OVERCORRECTION IN WHICH THE FEET ARE FIXED AFTER THE OPERATIVE TREATMENT.—(*Whitman.*)

One would suppose, after using the force that has been necessarily applied, that much pain and swelling would follow. This is, however, not the case. Often, on the following day, the patients are able to stand upon the foot, and always within the first week if the bandage has been properly applied. The pain following this operation is far more often caused by pressure of an ill-fitting bandage than by the violence that has been used. Thus one should be careful to remove sections of the bandage if it appears to cause undue discomfort. The points of discomfort are usually the front of the ankle, the back of the heel, and the inner border of the great toe.

The first bandage should be removed at the end of about three weeks, as it will have become loose. The foot will then be found to be extremely flexible, and by an enthusiast it might be considered cured. But knowledge of its previous condition should make it evident that a much longer time will be required for its consolidation in the new position. At this time almost no evidence of the operation remains, except, it may be, slight discoloration of the skin. The foot is again held as far as possible in the overcorrected position and another plaster

bandage is applied, usually as far as the knee only. This remains for four weeks, or longer if it is still unbroken. The patient uses the foot constantly, and is drilled in the proper method of walking, so that the muscles of the leg may become accustomed to the new and normal attitudes. This second bandage is allowed to remain from four to six weeks.

In some instances the deformity is now actually cured, but in the great majority of cases, while the foot may be normal in appearance, its muscular balance has not been restored. If, at this stage, treat-

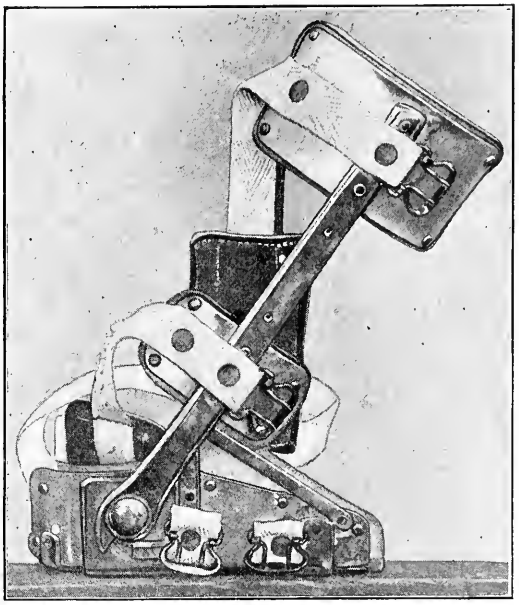

FIG. 132.—TAYLOR CLUB-FOOT BRACE.—(*Whitman.*)

ment be abandoned, the deformity will invariably recur. The foot should be supported in the proper position, aided by massage and stimulation of the muscles, until the child has been able to walk firmly upon it.

The Retention Brace.—The form of retention brace will vary somewhat according to the indications of the individual case. The best and simplest support is the Taylor brace, the invention of Dr. C. F. Taylor, of New York. (Figs. 133, 134.)

This consists essentially of a light upright that extends along the

inner side of the leg to the knee, and a thin steel foot-plate, the exact size of the sole, with an upright flange on the inner side, rising to a point just above the dorsal surface of the foot, against which the foot is pressed closely so that recurrence of the varus deformity is prevented. The joint at the ankle is provided with a catch that prevents plantar flexion, but allows dorsal flexion. By bending the upright and the sole-plate, the foot may be held in slight abduction and eversion. The apparatus is applied with straps, as illustrated, and if necessary, its position is further fixed by a band of adhesive plaster, applied on the inner side of the leg to hold the heel firmly against the foot-plate. The foot is thus held constantly at a right angle to the leg, or, better, in the early stage of

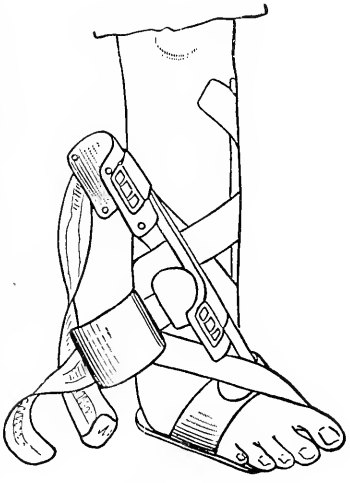

FIG. 133.

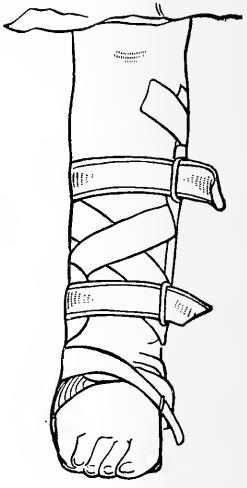

FIG. 134.

Taylor club-foot brace, showing method of application and attachment.—(*Whitman.*)

treatment, in an attitude of dorsal flexion and valgus. Occasionally after complete rectification of the deformity, the foot still turns in. In most instances this is due to an inward rotation of the tibia on the femur at the knee-joint, but in some cases it is caused by a spiral twist of the tibia itself.

In order to correct this secondary deformity an extension of the upright of the brace is carried beneath the leg, provided with a joint at the knee, and is extended up the outer side of the thigh. At the hip it is attached by a free joint to a padded pelvic band of light steel. The band holds the upright in the proper relation to the thigh; thus, by twisting

the part below the knee the foot can be rotated outward to the desired degree. In less marked cases the retention bands used for pigeon-toe may be employed.

Methodical Manual Correction.—Several times during the day the brace should be removed in order that the foot may be thoroughly massaged and forcibly turned, first toward valgus, that is, outward at the mediotarsal joint so that the inner border is made convex, and then to the extreme limit of dorsal flexion and abduction. If the leg is rotated inward, it is forcibly rotated outward on the femur. Even if the tibia is actually twisted on its long axis, the influence of the brace and forcible

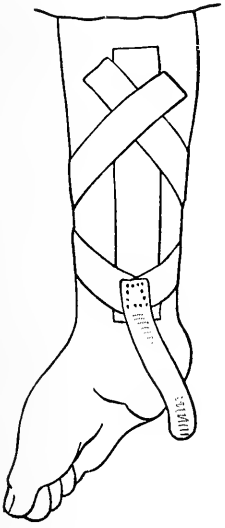

FIG. 135.

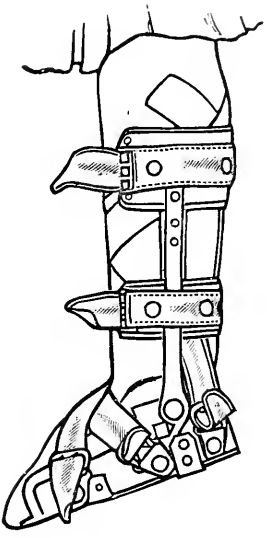

FIG. 136.

Taylor club-foot brace, showing adhesive plaster, by means of which the heel is held down, and the method of attachment.—(*Whitman.*)

manipulation will usually correct the deformity. Active contraction of the weak muscles may be induced by tickling the sole of the foot or by the use of electricity; and, finally, the entire limb should be thoroughly massaged before the brace is reapplied.

When the deformity shows no tendency to recur, the brace may be removed for a part of the day; later it is used only at night, and finally it may be discarded if the child walks normally. But it is best to continue the daily manipulation, more particularly the systematic stretching or overcorrection of the foot, for a long time. Thus one may assure one's

self that there is no tendency toward deformity, of which the first symptom is always a slight limitation of the range of dorsal flexion and of abduction.

In some instances the deformity may have been so thoroughly overcorrected by the plaster-of-paris bandage or by the brace, and the after-treatment of massage and stretching may have been so efficiently applied by the nurse or parent, that the retention brace may be unnecessary.

On the other hand, the inclination toward deformity may be so marked that a brace may be necessary to hold the foot in slight abduction and valgus for a year or longer. In other cases the use of a light brace to hold the foot in the overcorrected position during the night is alone required. These are points to be decided by the circumstances in the case. The period of observation and supervision is included in the final stage of the treatment.

During this period the attitudes of the limb and foot of the walking child must be carefully watched, and particularly the signs of wear on the sole of the shoe. If it shows greater wear on the outer side than is usual, it is an indication that the weight does not fall directly on the center of the foot, but to the outer side, and that there is therefore a tendency toward deformity. This must be counteracted by making the sole thicker on the outer side, or slightly wedge-shaped, so that the weight may be deflected toward the inner border.

This third period of treatment, or rather of oversight of the functional use of the foot, must be continued indefinitely. In fact, *it is the quality of this final supervision that decides in most instances whether the ultimate outcome is to be what is called a satisfactory result, or a perfect cure.*

TALIPES CALCANEUS.

After-treatment.—Whatever surgical method be adopted, care must be taken to keep the foot in a position of somewhat marked equinus for at least six or eight weeks, so as to permit sound union between the divided ends of the tendon; even after this time great care has to be exercised not to put strain on it for fear of stretching the uniting structure. The patient should not be allowed to walk about to any extent for at least six months after the operation. When walking is permitted, he should be furnished with the apparatus here described. This consists of the lateral irons fitted into a surgical boot with a stop which prevents the joint being flexed beyond a right angle. From six weeks

after the operation the calf should be thoroughly massaged and douched once or twice daily, and the faradic current applied to the muscle.

Transplantation of Tendo Achillis.—The other plan sometimes employed is not to divide the tendon at all, on account of the danger of subsequently stretching the uniting tissue, but to alter the bony attachment of the tendo Achillis to the os calcis. When, owing to paralysis, the nutrition of the leg is faulty, and when, therefore, the union in such a slightly vascular structure as tendon will very probably be extremely imperfect, there is no doubt that a more satisfactory result will be obtained by altering the point of insertion of the tendo Achillis into the os calcis. The great objection to this plan is, however, that the amount of shortening obtained by its means is comparatively limited, and the method is of real value only when the deformity due to talipes calcaneus is very moderate.

Two operations have been recommended; in the first a flap with its convexity upward is raised over the heel, and dissected downward so as to expose the whole of the posterior part of the os calcis. A saw is then applied to the upper surface of the bone immediately in front of the tendon, and, by a vertical cut, a thin slice of the bone, with the attached tendo Achillis, is sawed off. This slice of bone is pulled down until the insertion of the tendon is at a point as low as may be necessary, or as low as possible, and the bone is fixed into its new position by two or three small screws or nails. The projecting lower portion of the slice of bone is then cut off so as to make it level with the under surface of the os calcis.

In some cases in which the tendon is very long it has been advised that the upper part of the bone thus sawed off should be turned round at a right angle and applied to a raw surface made by cutting off sufficient of the under surface of the os calcis; this is done to bring down the insertion of the tendon to the lowest possible point. The results of attempts to produce great shortening in this manner do not, however, seem to be very satisfactory.

After-treatment.—After the operation the wound is stitched up without a drainage-tube, the usual antiseptic dressings are applied, and the foot is put upon a splint so that the toes are markedly pointed, and are kept in that position for about six weeks, until bony union is complete. After that time the patient may be allowed to walk about with the boot already described.

OSTEOTOMY FOR CURVED TIBIA AND FIBULA.

After-treatment.—According to Cheyne-Burghard, the limb should be put on a splint, and for this purpose we generally employ a trough of Gooch's or Day's veneer flannel or kid-lined splinting, for the first few days, until the wound has healed and the stitches are removed. This trough is cut of sufficient breadth to surround rather more than half the limb, and to extend from the fold of the buttock, where it is cut away obliquely from within outward and upward, to well below

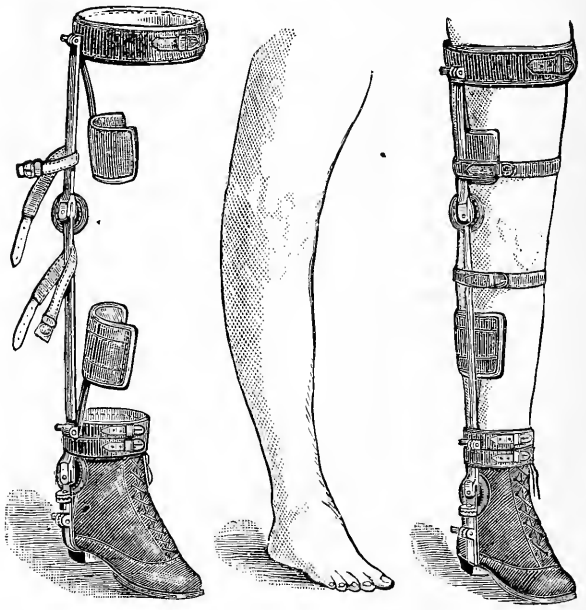

FIG. 137.—DR. CHAS. F. STILLMAN'S LONG BOW-LEG BRACE.

the foot. A portion of the splint should be cut out opposite the heel so that no injurious pressure shall be exerted, but in quite small children this need not be done; instead, the padding may be so arranged that the heel is pushed somewhat forward and at the same time does not press upon the splint. The limb is made to fit the splint exactly by means of a number of pads of suitable size and shape, packed in on each side and below the limb, which may thus be fixed in any position that is most suitable. It is well to place a special pad over the front of the knee and leg, and by graduating the padding any desired amount of inversion or eversion of the foot can be obtained; generally speaking,

a large, long pad should be applied opposite the point of greatest convexity of the curve that it is required to obliterate, and smaller, thicker ones between the ends of the bones and the side of the splint. The latter is then fastened round the limb by broad bandages, and the whole is laid upon an inclined plane, to which it may be secured by one or two strips of bandage.

In about a week or ten days the splint may be undone, the stitches removed, and a collodion dressing applied. Any additional correction of the deformity may then be made, if necessary, under an anesthetic, and the limb put up in the fully rectified position in a plaster-of-paris or silicate of potash bandage and left for about six weeks for union to occur; it is, of course, necessary that the foot should be strictly at a right angle. In six weeks' time the old bandage may be taken off and a fresh one applied for a similar period, when the union should be thoroughly firm, after which a Stillman's long or short brace should now be applied and worn for several months (see Fig. 137).

This apparatus exerts a constant spring force, which tends to overcome or prevent deformity. It is adjustable by means of rachets and a key, and is very effective, for not only does it support the limb while the deformity is being reduced, but the rachets at the lower extremity of the instrument allow the surgeon to control the position of the feet at the same time.

The short brace is worn only below the knee, and is intended merely for cases in which the curvature is slight or entirely below the knee.

OSTEOTOMY FOR GENU VALGUM.

After-treatment.—Cheyne states that after the completion of the operation one or two sutures should be inserted, an antiseptic dressing applied, the limb brought straight and put upon a suitable splint, which we are accustomed to make from a roll of Gooch's or Day's splinting properly padded. If an ordinary straight splint is used, it is well to cut away a space for the heel so as to obviate all fear of pressure upon the os calcis. In applying the padding special care must be taken to have a large pad over the internal condyle, and others over the outer side of the foot and ankle, so as to press the leg inward and keep it in good position. Another special pad must be placed in front of the knee so as to prevent flexion at the joint.

After the splint has been applied the limb should be laid upon an inclined plane. In about a week or ten days the dressing may be taken

off, the stitches removed, a collodion dressing applied, and the limb put up in a plaster-of-paris or silicate bandage. In small children, and in any case in which there is much curvature of the femur, it is well to continue the bandage up around the pelvis, otherwise the casing may fail to get a sufficient hold upon the thigh. After about six weeks union will generally be firm and the splint may be left off, but the child should be kept in bed for two or three weeks longer, and allowed gradually to recover the full range of movement in the knee.

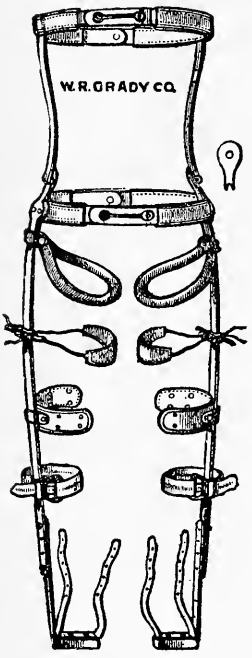

FIG. 138.—OUTSIDE IRONS FOR USE AFTER OPERATION FOR GENU VALGUM IN ADULTS.—(*Erichsen.*)

During this time the leg should be massaged and rubbed, so as to improve the circulation and the tone of the muscles. Walking may be permitted in about ten weeks, and, should the rachitic condition of the bone have completely passed off, no further apparatus will be required. When the osteotomy has been done upon a young adult in whom there is some doubt as to whether the bones have become firmly consolidated, it is well for the patient, after operation, to wear one or other of the forms of apparatus which are usually employed to exert mechanical pressure upon the deformity. This generally consists of an outside iron fastened to the pelvis above and the heel of the boot below, and furnished with hinges opposite the hip-joint, knee-joint, and ankle-joint (see Fig. 138). There is also generally a band or sling which tends to draw the knee outward against the iron. This apparatus can be made of quite light material, and should be worn for two or three months after operation.

Should genu valgum occur after excision of the knee, the choice will lie between a fresh excision or Macewen's operation; in most cases the latter is less severe and is an equally satisfactory method. Should genu valgum occur in connection with infantile paralysis, the usefulness of the limb will have to be taken into consideration; in some cases it may be best to perform excision of the knee-joint, so as to give the patient a firm and fixed point of support, while in others in which the muscles are fairly healthy, a Macewen's operation, or any of the other operative procedures which we have mentioned, may be employed. (Cheyne.)

CHAPTER XIX.

VALUE OF RÖNTGEN-RAY IN POSTOPERATIVE TREATMENT; MANNER OF APPLICATION.

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VALUE OF RÖNTGEN-RAY IN POSTOPERATIVE TREATMENT; MANNER OF APPLICATION.

RÖNTGEN-RAY THERAPY.

General Considerations.—Since the discovery of the therapeutic value of the Röntgen-rays in certain forms of chronic skin diseases, a large number of medical men have been engaged in testing the effects or determining the value of these rays by actual clinical demonstrations upon various forms of malignant growths, the result being that, while the curability of the large, deep-seated, hard, and especially internal cancers, is still a matter of impossibility by means of any apparatus yet devised, there can be no doubt that superficial cancers, especially the epitheliomas and the softer varieties of mammary cancer, and some forms of tuberculous enlargements, are curable by this means, yet the fact remains that even in these cases the cure in the majority of instances is more quickly and more satisfactorily accomplished by operative measures.

The experience of the author, which has been somewhat extensive, fully agrees with the statement already advanced by Leonard, Lund, and others, and, in fact, now generally conceded by unbiased observers, that the Röntgen rays should not be employed, as a rule, as a preliminary method of treatment except in cases distinctively inoperable, or when cosmetic effects are desired, and life is not threatened by delay.

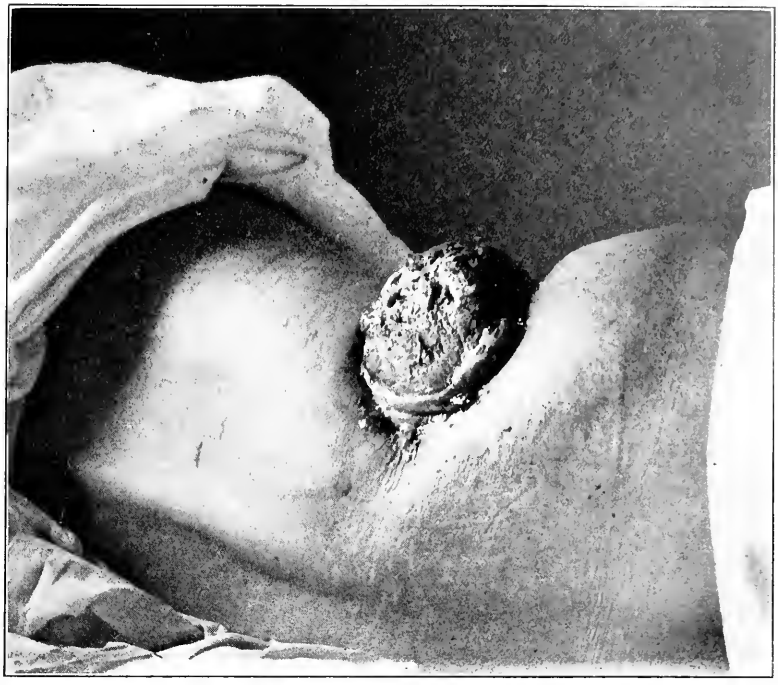
It has also been the author's experience that even in cases of epithelial cancer, the application of escharotics, in case the patient refuses other operative treatment, as a preliminary measure, often proves highly beneficial, and increases greatly the therapeutic action of the Röntgen-ray, and shortens greatly the time required for treatment. In all other cases of any magnitude surgical treatment should always precede the application of the rays. It would be manifestly absurd to attack by radiotherapy a large scirrhous cancer of the breast, the removal of which, even if possible by this means, would require many months of treatment, when an equally favorable, if not better, result would be obtained in the course of a few days by extirpation. Again, the liability of flooding the system with toxins by causing rapid destruction and absorption of cancer tissue

or growths of low vitality has not by any means been exaggerated. When insisting upon Röntgen-ray treatment, the patient should be informed upon this subject.

Dosage and Method of Treatment.—Many writers affirm that the source of electric energy and choice of apparatus are of secondary importance, provided a proper tube is used, the static machine or the coil giving equally good therapeutic results. In the author's opinion, nothing could be more fallacious or misleading. Familiarity with and constant use of both forms of apparatus have convinced me that the larger coils are far more valuable in Röntgen-ray therapy, and only by their use may we expect in the future greater success and more permanent effects than are now supposed to be possible. This country is flooded with cheap static machines and other apparatus, and many failures are due to the employment of inadequate dosage. In the treatment of malignant growths I have long since abandoned the use of the ponderous glass static machine. Röntgen-ray dosage is just as important in Röntgen-ray therapy as the action or knowledge of drugs in physical ailment, and when Röntgen-ray administration can be so regulated as to produce certain effects in all cases, scientific dosage can then be determined upon. All tubes should be carefully tested as to penetration.

The degree of vacuum in a Crookes tube is more accurately determined by the internal resistance of the tube than in any other way. You will determine this by connecting to the terminals of the exciting apparatus without having spark gaps in series; then by bringing the discharge rods or other conductors connected to the prime conductors within a short distance of each other, a point will be reached where the current will pass between the discharge rods rather than through the tube. If the resistance of the tube be low, the spark gap will be short, whereas, if the resistance of the tube be high, the spark gap will be longer in proportion to the degree of vacuum.

In making this test as to the degree of vacuum, a spark gap should not be used in series with the tube, because a spark gap sets up an inductive action which produces a counter-electromotive force in the stems of the tubes supporting the terminals, and would cause additional resistance on this account. For example, a tube that will back up a spark gap of one-half inch without spark gaps in series should back up only an inch and a half with two one-half inch spark gaps in series with the tube, but it will be found that with the spark gap in series the tube will back up a much longer spark gap than an inch and a half, showing



POSTOPERATIVE KELOID GROWTH OR TUMOR FOLLOWING AN OPERATION FOR ABSCESS OF RIGHT KIDNEY.

Growth removed by the combined use of escharotics and X-ray.

that the counter-electromotive force developed in the stems or metal terminals of the tube is quite great. This varies according to the construction of the tube. The use of auxiliary anodes greatly overcomes this factor, so that tubes of different types vary in this respect. The tube with the least internal resistance for a given degree of vacuum is undoubtedly the best for both Röntgen-ray and therapeutic purposes. (Wagner.)

In applying the Röntgen-ray treatment the technic is simple but subject to great modifications according to the experience of the operator, nature and extent of the growth, idiosyncrasies of the patient, and variety as well as penetration of the tube used. The duration of exposure and the distance of the tube from the field vary considerably, and a knowledge of these can be obtained only by actual experiment.

The distance of the tube from the parts treated must vary at times from 3 to 10 inches, and the time of exposure varies from five to fifteen minutes. It is the author's custom to commence treatment with the tube at a distance of 10 to 12 inches, gradually decreasing the distance as the patient becomes accustomed to its effects, or the parts treated indicate closer or stronger application. As to the frequency of treatment, much depends upon the effect produced or noticed. Daily treatment is frequently necessary at first; later, once or twice a week will usually prove sufficient. In dealing with morbid growths, there is a strong probability that the rays act cumulatively; therefore, if signs of dermatitis or erythema appear, the treatment should be suspended until they have subsided. If the effects of the Röntgen-ray treatment are pronounced, the length of time of exposure during treatment should be lessened, or the tube moved farther from the part treated, extreme care being necessary to prevent overstimulation of the absorbents. Should this condition of overstimulation occur, all beneficial action may suddenly cease, and further treatment will have to be suspended until, by rest, the circulation of the parts improves and the tissues and absorbents return to their normal condition.

Some writers contend that no effect is noticeable upon the deep-seated carcinomatous disease until reaction of the tissues about the growth occurs. They therefore aim to use a high-vacuum tube with an amount of penetration sufficient to produce this reaction quickly. There can be no question that this theory is correct. The absorbents should be stimulated, but, as before stated, should never be overstimulated, for if stimulated beyond their capacity, negative results must follow.

Exposures for deep-seated, malignant growth should, therefore, not be given oftener than two or three times a week, commencing with five- to ten-minute exposures, and increasing the length of time according to the effects produced upon the affected part.

Effects of Treatment.—The claims made for Röntgen-ray treatment in surface malignant growths of all types are summed up as follows by Morton: (1) Relief from excruciating pain and constant suffering; (2) reduction in size of growth; (3) establishment of process of repair; (4) removal of odor if present; (5) the cessation of the discharge; (6) softening and disappearance of lymphatic nodes; (7) disappearance of lymphatic nodes not directly submitted to treatment, and often quite distant; (8) removal of cachectic color and appearance of the skin; (9) improvement in general health; (10) cure of many undoubtedly malignant growths, confirmed by absence of relapse after many months of observation.

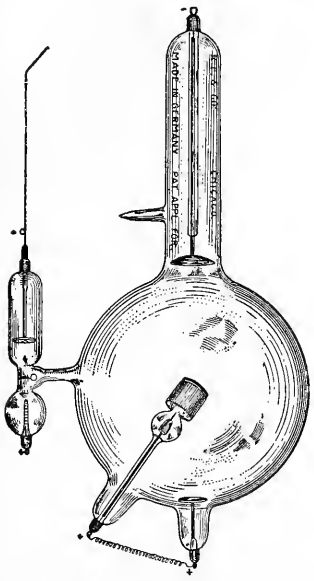


Fig. 139.—Röntgen-ray Tube with Vacuum Control.

The results obtained from the rays for postoperative recurrence or in inoperable cases are shown in a paper written by Holding.* He reports 148 cases collected from literature, with four of his own in addition. A study of these cases shows that 32 percent were apparently cured, 58 percent were improved, and only 10 percent unimproved. As noted before, the most favorable results were obtained in cases of superficial growth, such as epithelioma of the face and mammary carcinoma.

Of the six cases reported by Pusey of intra-abdominal cancer, the result was unfavorable in every instance. Turner reports (London "Lancet") 18 cases of inoperable recurrent malignant disease. Marked improvement was shown in all, but the best results were obtained in the mammary cases. He also noted diminution of pain, loosening of adhesions, and relief from contracting and tightening sensation.

Bryant reports cases of recurrent or inoperable cancer of the rectum which were amenable to Röntgen-ray treatment.

* "Albany Medical Annals," Feb., 1903.

Roswell Park,* in an article upon the subject, concludes as follows: The Röntgen-rays afford a method of treatment for extremely new growths of limited area and superficial character which, while not exactly certain, is extremely promising. They not only cause no pain, but tend to relieve pain, both superficial and deep, in a most satisfactory manner. They are adapted to cases which can hardly be submitted to any other method of treatment, and they afford more hope in recurrent, delayed,

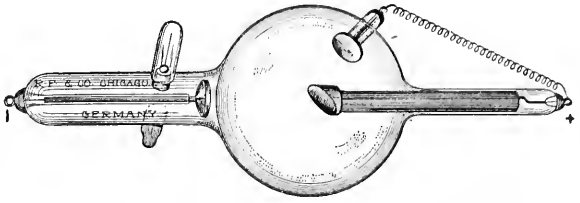


FIG. 140.—GUNDELACH TUBE WITH HEAVY ANODE.

or inoperable cases than any other method of treatment. More than this, the rays afford a supplementary method of treatment after operation, by which the benefits of the same may be enhanced and enlarged.

Character and Kind of Tube.—The majority of observers agree that for the treatment of superficial growths, soft tubes or tubes of low resistance are preferred; and for deeper growths, hard tubes or those

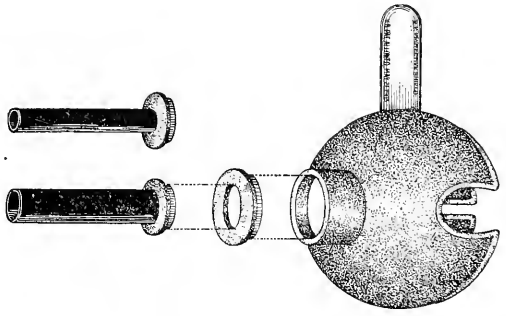


FIG. 141.—HARD-RUBBER MASK.

of high resistance are necessary. The ordinary tubes have such changeable vacuums that they are unsuited for Röntgen-ray therapy, and only those tubes which permit perfect control of the vacuum should be employed (Fig. 139).

The author prefers high-vacuum tubes because they give good results in the treatment of the deeper tissue, not affected by low-vacuum

* "Med. News," May 30, 1903.

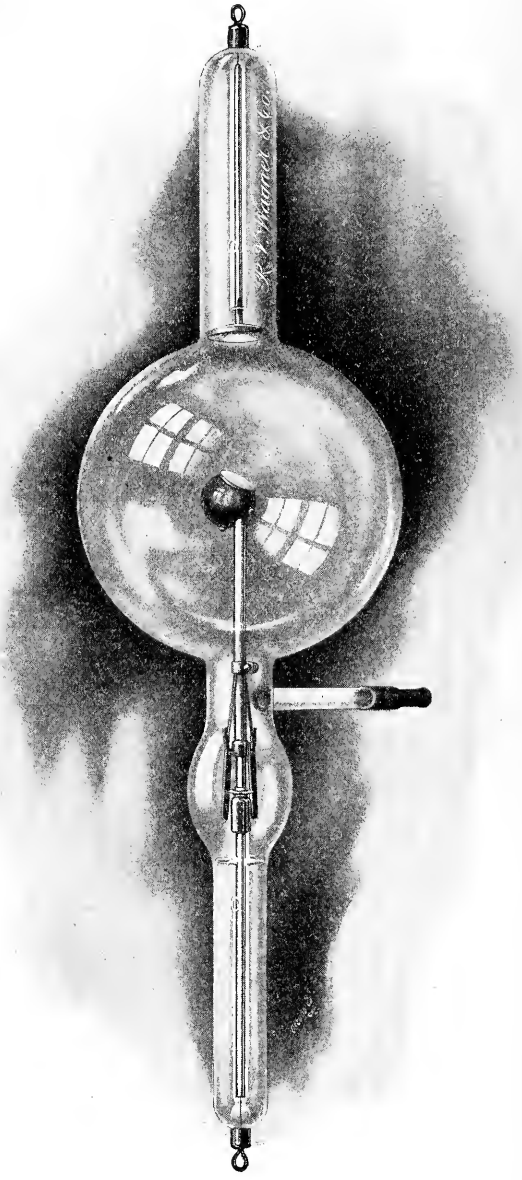


FIG. 142.—IMPROVED WAGNER TUBE WITH ADJUSTABLE ANODE.

tubes, while the high-vacuum tubes give equally as good, if not better,

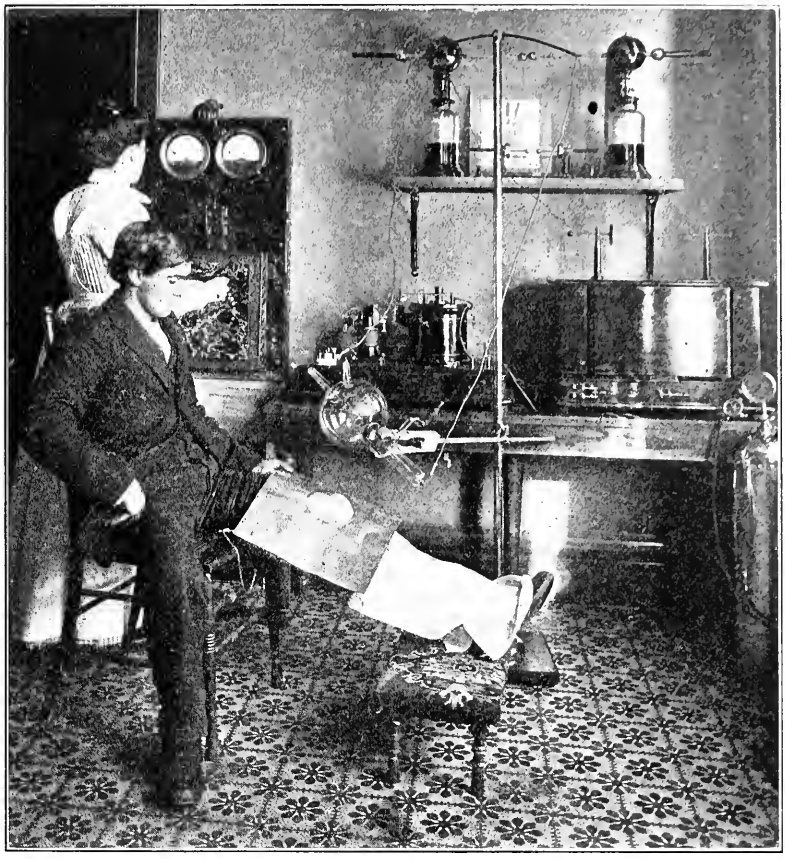


FIG. 143.—SHOWING MANNER OF APPLYING THE RÖNTGEN RAYS TO TUBERCULOUS KNEE.

results in the treatment of superficial conditions, provided a little longer exposure is made.

The author prefers for superficial work the ordinary "Gold-Medal" or Wagner's adjustable focus tube (Fig. 142); for deep penetration, the improved large-sized R. F. universal regulating tube (or Gundelach heavy anode tubes) (Fig. 140).

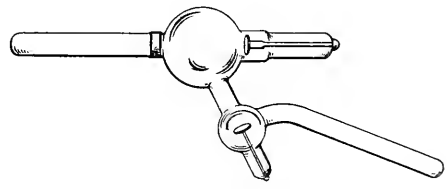


FIG. 144.—CALDWELL TUBE.

For rectal or vaginal treatment, the Caldwell tube is preferable (see Fig. 144). These tubes are made with a water-jacket and the

FIG. 145.

FIG. 146.

FIG. 147.

FIG. 148.

TYPES OF EPITHELIOMA CURED BY RÖNTGEN-RAY TREATMENT.

cathode so arranged that the main direction of the Röntgen-rays emitted is at an angle to the axis of the tube, the anode being

grounded. It is introduced within the vagina, and a Pennington brass shield is used if it is desired to limit the area of radiance. Owing to the fact that the tube is brought in close contact with the parts under treatment, the duration of exposure must be lessened in accordance therewith.

Manner of Protecting the Patient.—In place of the cumbersome lead screens heretofore employed, the author uses a hard-rubber mask (see Fig. 141).

The Friedlander protective shield, although somewhat heavier, is equally efficacious. It not only protects the patient, but also the eyes of the operator, and admits of easy adjustment of the rays.

CHAPTER XX.

COMPENSATIVE OR ARTIFICIAL APPLIANCES.

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Where and How to Amputate.—L. E. Jepson states that for many years efforts have been made to construct a substitute for the natural limb, or to restore, in a measure at least, the functional uses of the amputated member. While great advance has undoubtedly been made and the work of the ingenious inventor greatly appreciated by patients, nevertheless the results will be far more satisfactory and gratifying when the operating surgeon realizes the necessity of working more in harmony with the prosthetist. This matter has already been referred to briefly on page 378, but as there seems to be so very little reference to this subject in our modern text-books, we deem it advisable to present the views of an authority upon this interesting subject.

The anatomic facts regarding conditions of amputations requiring investigation may be summarized by the enumeration of certain difficulties experienced in a large majority of the amputations of the leg at any point below the junction of the middle and lower third, or the "point of election" (nine to ten inches below the knee).

The following are such difficulties:

(A) In a LISFRANC, TARSOMETATARSAL or—

(B) A CHOPART, MEDIOTARSAL AMPUTATION, the equilibrium of the tarsals forming the arch is destroyed, becoming simply a heap of angular fragments and almost invariably producing pressures and irritations, causing severe pain from its use. In a tarsometatarsal or a mediotarsal amputation the tendo Achillis almost always contracts to such an extent as to pull the heel up and the amputated surface down, thereby elongating the stump and making necessary an artificial leg which will not touch the end, and the use of an elevated sole on the other foot to counteract the extra length. In a mediotarsal amputation the astragalus is very liable to become displaced from its intermalleolar position causing serious trouble.

(C) A TIBIOTARSAL AMPUTATION (PIROGOFF or SYME) at the ankle-joint, even with the most favorable results, which are seldom secured, necessitates a large and cumbersome appliance about the ankle,

and, moreover, seldom gives comfort or satisfaction to the wearer. With the foregoing amputations it is many times mechanically impossible to secure a satisfactory fit and adjustment for prosthetic apparatus.

(D) In AMPUTATIONS OF THE LEG between the "point of election" and the ankle it was observed and noted that the healing process was long and stubborn, while a certain percentage of such cases absolutely refused to heal in a satisfactory manner. It was further noted that almost invariably the stump was extremely sensitive to heat, cold, and the touch, and also subject to swelling, ulceration, and abscess. It was again noted that the patient usually elevated the stump to the highest

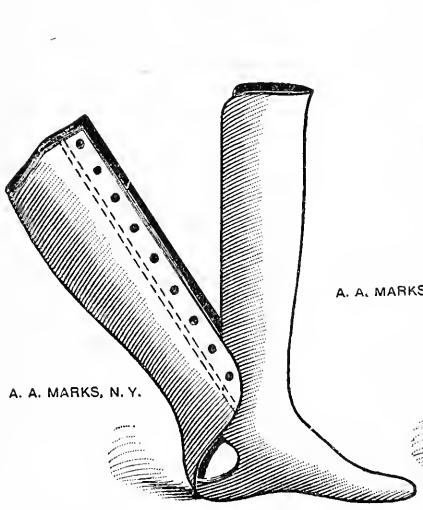

FIG. 149.—CHOPART AMPUTATION.

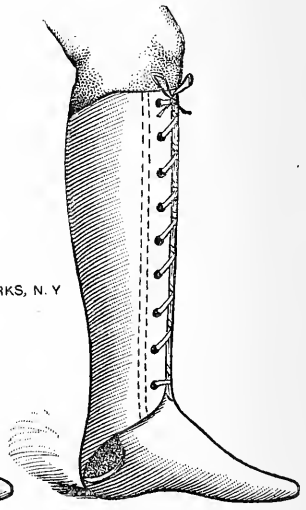

FIG. 150.—SYME'S AMPUTATION AT ANKLE-JOINT.

position in sitting or reclining, the same procedure being followed by those wearing artificial legs, thereby reducing the swelling and relieving the throbbing, bursting, and painful feeling of the extremity. It was inferred that these difficulties were the result of deficient circulation, and an anatomic investigation confirmed the theory and established the fact. At about the middle of the mid-third and in the foot the collateral circulation is found to be complete, but between these two points there is very little collateral circulation. It therefore follows that the extremity of a stump made by amputating between these two points is practically devoid of circulation, the blood simply stagnating in the

end, resulting in a swollen, inflammatory condition which nature tries to relieve by ulceration and abscess. The most satisfactory place of amputation below the knee is the middle of the mid-third, and at this point the best results are secured from a prosthetic point of view.

(E) AMPUTATION OF THE LEG higher than the junction of the upper and the middle thirds detracts from the use of the stump in throwing the leg forward in walking. In these amputations, especially those made just below or near the head of the fibula, it was observed that the lower end of the fibula was a constant source of trouble in wearing an artificial leg. The stump becomes more and more atrophied by wearing an artificial leg, and the more the shrinkage, the more prominent the fibula. The trouble is caused by this lower end of the fibula rotating outward and coming in contact with the socket of the artificial leg, often resulting in periostitis and almost invariably in an enlarged, sore, and irritable condition and extremely sensitive to the touch. Many times it has been absolutely necessary to have it removed before an artificial leg could be worn with any degree of comfort. In the present advanced state of surgery it is no more of a major operation, while the amputation is being made, to remove the fibula. The objections against removing the fibula entire are more theoretical than practical, being mainly that the leverage might be somewhat lessened by taking out the head of the fibula, also the very slight risk of opening the knee-joint.

A SINGLE LONGITUDINAL INCISION on the outer side of the fibula exposes the bone. The periosteum being carefully separated and the bone separated from its ligamentous attachment can be removed without destroying the action of the external hamstring or biceps tendon. While this tendon is inserted into the head of fibula it also embraces the external lateral ligament of the knee-joint, and has a strong attachment to the outer tuberosity of the tibia. The short fibula has no function whatever, and at the best makes an ill-shaped stump and its removal obviates all difficulties. Although this may be considered an innovation, yet experience warrants the statement that in these short amputations it should always be removed.

(F) AMPUTATIONS AT THE KNEE as formerly made often resulted in tender, irritable, and sensitive stumps; but with a proper amputation, they are most useful and satisfactory. In such cases the end of the femur must not be disturbed, the condyles untrimmed, and the cicatrices carried high from the end with posterior flaps. If the patella is uninjured, an experienced and skilful surgeon may, under favorable cir-

cumstances, successfully bring it down over the end of the femur and place it in the depression between the condyles, nevertheless; from our experience, we believe it is better to remove it, for whenever the patella withdraws from the intercondylar notch it presents serious difficulties in wearing an artificial leg.

(G) Amputations of the thigh made too close to the knee do not leave room for the artificial knee. The amputation should be made three or four inches above the knee. Whenever it is necessary to amputate higher than the junction of the middle with the lower third, every inch possible, and consistent with a good flap, should be saved.

(H) The position of the cicatrix it was also found by practical observation in fitting limbs, had much to do with the comfort of the patient in wearing limbs. The cicatrix should never come over the end or anterior part of the stump. If a long anterior flap is used the cicatrix can fall posteriorly. The position of the scar has been largely changed to accommodate the artificial limb.

(I) The bone should be sacrificed to the perfection of the flap if the amputation is to be made below the middle of the mid-third. If the amputation is to be made above the middle of the mid-third the perfection of the flap should be sacrificed to the length of the bone. To secure leverage, every inch above the middle of the mid-third should be saved.

(J) Postoperative Condition of Nerves.—One of the most serious defects in amputating was found to result from leaving the nerves exposed too near the extremity, resulting in an irritable and painful condition, and often resulting in neuroma. It has been necessary to advise many patients to undergo an operation to correct the results of ignorance of this fact in amputation.

(K) Postoperative Conditions of Bone.—It was also observed that serious results followed the leaving of sharp edges and corners of bone, which, upon attempting to apply an artificial leg, caused tender, irritable, and sore places, the bone at times actually piercing the skin. All edges and sharp corners should be well rounded off.

(L) Redundant tissue on the end of the stump is a positive detriment, and produces evil results by easily becoming inflamed and tender. The extremities should be well covered, but nothing more.

(M) The Size of the Stump.—It was found that in most cases, as the result of improper treatment, the stump had been allowed to become abnormally large. There is a tendency with most stumps soon after

healing to take on adipose tissue, thereby becoming large, soft, and flabby. Many surgeons seem to believe that an attenuated stump was a misfortune. This has been one of the greatest errors and most prevalent evils that have had to be met and overcome. It is an established fact that any stump when left to itself will become hypertrophied, and by wearing an artificial leg will become atrophied. It is therefore wise to

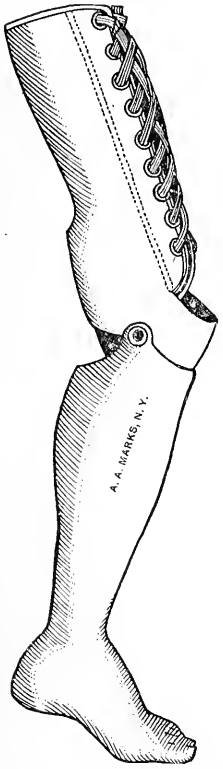

FIG. 151.—SHOWS CONSTRUCTION OF ARTIFICIAL LIMB; FOR AMPUTATION SIX INCHES BELOW THE KNEE.

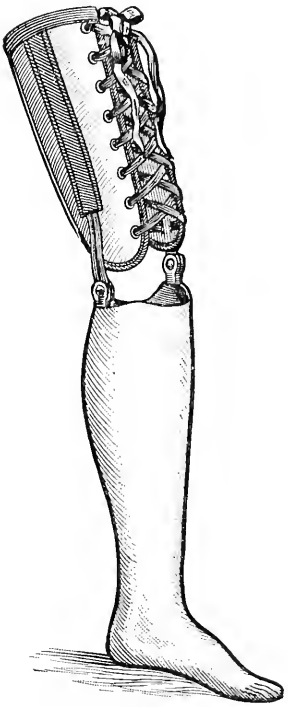

FIG. 152.—ONE OF THE LATE DEVICES, DOUBLE SOCKET ARTIFICIAL LIMB; FOR AMPUTATION BELOW THE KNEE. IMPROVED FELT FOOT.

minimize the shrinkage of the stump as the result of wearing an artificial leg, and thereby minimize the necessary changes in the socket to counteract such shrinkage. It was further found that in most cases of attempted treatment the stump was imperfectly prepared at the best. The old method was to bandage tightly, retarding the circulation, producing uneven shrinkage and affording no protection from accident. Again,

whenever a stubborn hypertrophied stump failed to yield to bandages it was thought necessary to apply a temporary artificial leg in order to reduce the stump, which was done at the inconvenience and expense of the wearer. This method was everywhere prevalent and among all manufacturers. In the place of the bandage and temporary artificial leg there has now been substituted a leather corset, lacing about the stump and producing by its firm and evenly distributed pressure rapid and uniform shrinkage, giving a conical shape, which is greatly to be desired. and all this has been done without interfering with the circulation. This treatment also affords a most perfect protection against injury from accident.

General Remarks.—The artificial leg must be as light as possible, but should be of sufficient weight to assure the wearer sufficient strength

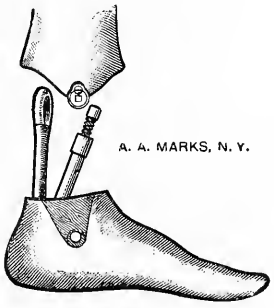

FIG. 153.—IMPROVED SPONGE RUBBER FOOT, WITH ANKLE-JOINT.

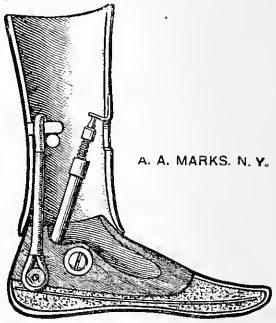

FIG. 154.—SHOWING MEXICAN FELT FOOT WITH ANKLE-JOINT.

not only to carry the weight of the body, but to withstand the requirements of his occupation. By the use of the best-grade material, skill, and painstaking workmanship, the limb may be made exceptionally light in weight and also strong and durable (see Figs. 151, 152).

Some prefer the rubber foot. It cannot be made as light, however, as a willow, wood, or felt boot.

THE LOCATION OF THE WEIGHT IN AN ARTIFICIAL LEG has much to do with its seeming heaviness; thus, two legs made for the same person, each weighing five pounds, one may feel very heavy and the other light. A leg with a light upper part and a heavy foot would be called a heavy leg, and a leg with a heavy upper part and a light foot would be pronounced a light leg.

The majority of artificial legs are worn by the laboring classes, their

occupation subjecting them to more frequent injury. Comparatively few are financially able to purchase a duplicate artificial leg, hence the leg should be made as strong and durable as possible, that repairs and loss of time may be avoided, and due consideration should be given in selecting and purchasing an artificial limb.

Children requiring artificial limbs should be fitted so soon as possible; as early as the fourth or fifth year they may be adjusted and worn with comfort. Adjustable limbs adapted for the growing child have now been perfected and are quite satisfactory. The most graceful and easy walkers are those who commence the use of the artificial leg in youth, and by the time they are grown it has become second nature to wear a leg.

How to Prepare a Stump for an Artificial Limb.—It is of great importance that the stump be prepared before being fitted into an artificial leg. This is accomplished ordinarily by keeping the stump tightly bandaged from the time it is sufficiently healed until the artificial leg is worn. Bandage from the end of the stump to the knee if the amputation is below, or to the body if the amputation is above, the knee.

The tight bandage seems to solidify and tighten the stump, which otherwise becomes soft and flabby. Some of the manufacturers prefer the leather corset, claiming that it is better, holds the limb in position more firmly, is more easily applied, and is far more comfortable to the wearer, and also tends to give the stump the desired conical shape.

The corset should be worn either next to the stump over a well-fitted stump stocking or a thickness of the underclothing, according to the preference of the wearer. It should be worn continuously day and night, and adjusted as tightly as possible without causing undue discomfort.

If the amputation has been made below the knee, the knee-joint should be exercised and straightened as much as possible to prevent flexion or ankylosis. Applications of electricity and massage may frequently be used to advantage.

Artificial Hands and Arms.—Despite the unwarranted and exaggerated statements of certain manufacturers, no artificial hand or arm has yet been devised that equals in benefit artificial legs, nor is this possible in case both arms have been amputated above the elbow, owing to the many complicated uses of an artificial hand.

In double amputations of the arms the greatest benefit in wearing artificial arms is the improvement in appearances, although the wearer

may, in the course of time, accomplish considerable along the lines of helpfulness.

A valise or heavy object can be carried, the weight coming on the shoulder-pad. In case but one arm has been amputated, however, the natural hand may be of great assistance, enabling the artificial arm to assume various flexed positions, and, owing to the arrangements of the shoulder-straps, the artificial hand may likewise be of great assistance to the natural. Many laboring men prefer a simple hook, and great utility may be derived in wearing such a contrivance. The rubber hand is preferred by many, for the reason that it possesses a flesh-like softness. The fingers and thumb may be bent or placed in the desired position with the natural hand, and they will remain in this position until rearranged. The artificial hand may be thus arranged and controlled by a button or spring enabling them to hold a knife, fork, brush, etc.

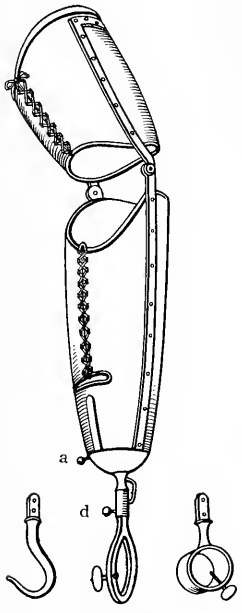

FIG. 155.—SUBSTITUTE FOR ARTIFICIAL HAND.

Fig. 155 illustrates one of the latest and most complete devices or substitutes for an artificial hand. By pressing a button at (a) the hand can be taken off, and the knife, fork, brush, or hook or any other instrument can be inserted in the end of the wrist as well as the palm of the hand. The spring controlled by the button (a) retains the tools in the end of the wrist, while the spring controlled by the button (d) retains tools in the palm of the hand. The hand and wrist attachments are the same for all amputations. When manual work is required, the hand is removed and the hook inserted in the forearm (see Fig. 155).

CHAPTER XXI.

POSTOPERATIVE DIETETICS.

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The feeding of patients after operation is one of the very important elements in after-treatment. The effect of food itself, as food, is probably a minor factor as compared with the complications it may produce, largely in a mechanical way, when injudiciously administered. Chief among these are nausea and its frequent successor, vomiting, either of which may result later in serious deprivation of food which the patient urgently requires. The latter not only more effectually than nausea prevents the taking of food, but also adds the element of physical strain, with the possible opening of wounds, contamination of operative sites, and the general hindrance of reparative and recuperative processes throughout the body.

Postoperative feeding depends to some extent upon the plan adopted in preparing the patient for the operation, but is so largely a matter by itself that the former may for practical purposes be disregarded. Suffice it to say that modern methods of preparation, which have shown the fallacy of the older belief in pronounced starvation as a preliminary, now leave the patient in a much better physical and mental condition to undergo the deprivation of food absolutely necessary after surgical intervention. By judicious feeding before operation, in all but emergency cases much can be done to prevent postoperative shock and allied conditions, the presence of which markedly interferes with the resumption of nourishment. This question has been discussed in the chapter on preparation, and the statements made need not here be repeated.

General Rules for Postoperative Feeding.—As a rule, regardless of nausea or vomiting, no food should be given a patient by the mouth during the first eighteen hours after operation, though circumstances may render advisable departure in either direction from this time limit. In the presence of positive indications, a previously well-nourished adult may safely go without food for two or even three days; on the contrary, either very young or old and exhausted persons must not for a long time be deprived of nourishment. Fortunately, both the last-named groups are relatively free from the disagreeable effects

of anesthesia, and often retain food that is given as early as eight to twelve hours after operation. A number of surgeons guard against postoperative nausea, and thus favor the early retention of food, by washing the stomach with warm water, until the latter returns clear, by means of a stomach-tube introduced while the patient is still upon the operating table. I have previously mentioned this expedient as a preventive of shock and postoperative thirst in all major operations; surgeons who do not adopt this as a routine procedure may well employ it with patients whose stomachs have been specially rebellious before operation. Persons profoundly exhausted before operation may soon after require nutrient enemas at regular intervals; in some of these cases a stimulant and nutritive combination of beef-tea, white of egg, and brandy may be placed high in the intestine before the patient leaves the operating room. Patients in whom operation has not involved the abdomen usually will tolerate feeding earlier than those in whom the peritoneum has been disturbed.

If, then, in ordinary cases at the end of eighteen hours the stomach has for some time been perfectly quiet, the fluid which has been given to allay thirst may be made to include, or be entirely changed to, liquid nourishment. This must be given in spoonful doses only, every one or two hours, until the retaining power of the stomach is tested. The proper beginning of food depends so largely upon the condition of the individual patient that any time limit is in a sense arbitrary; as an aid in this matter a careful, observing, and experienced nurse is at this period invaluable. One of the principal objections advanced by Hans Kehr against operating in private houses is the meddlesome interference of the family with the after-feeding of the patient. In the absence of a trained nurse in particular, but in every case in general, the surgeon must keep himself informed regarding every detail of the patient's behavior and must give definite orders when to begin feeding and what the food is to be. Should vomiting be provoked by the first trial, all fluids must be withheld for two or three hours; Vichy water may then be given. Under these circumstances McKay is partial to Semmola's glycerin drink, made by adding 1 ounce of glycerin and 30 grains of citric acid to 1 pint of water; this is useful from the beginning in allaying thirst. Albumin-water, made by straining the beaten whites of eggs, or better draining off the fluid part after it has stood for an hour, diluting three or four times with water, and adding sugar and lemon-juice, is an ideal substance with which to begin the feeding of patients. It is better

not to inform them what they are getting, as the thought of raw egg may render the mixture distasteful. The albumin-water should be freshly made every six hours, though in cold weather it may be kept at least twice this length of time. At the end of thirty or thirty-six hours the albumin-water may be substituted by peptonized milk, not carried to the point of bitterness, milk and Vichy, milk and lime-water, or a clear broth. One part milk, 2 parts cream, and 2 parts lime-water is a mixture that agrees with some persons. Given at first in spoonful doses, either may, if well borne, soon be increased to 1 or 2 ounces every two hours. Idiosyncrasy of the patient has much to do in determining the selection of the earlier diet-list. Perhaps of no substance is this more true than of milk, and before giving it, inquiry should be made as to whether it agreed with the patient during health. On the third day soft foods may be begun, and two days later be followed by light solids; at the end of a week ordinary diet may be resumed.

Diet for Laparotomy Patients.—After employing liquid nourishment in increasing amounts and at lengthened intervals for two or three days the patient may be given light soft foods selected from a list including oyster soup, junket, chicken jelly, various forms of gruel, etc. Two days later there may be added chicken or mutton broth with rice or barley, poached or very soft-boiled eggs, dry or milk-toast, oysters, and other soft foods. With patients who present no disturbing stomach conditions after operation it is wise early to discard liquid diet, as it has a tendency, especially in such persons, to cause an annoying degree of flatus. After four or five days McKay* finds gelatin blanc-mange a most acceptable food, and makes a routine practice of giving it to his section cases. He prefers the following formula: Of 1 quart of fresh milk, place 1½ pints in a double-lined saucepan. Soak 1 "quart" packet of gelatin in the remaining ½ pint of milk for two hours. Then stir this milk and gelatin into the milk in the saucepan, now brought to the boiling-point, and add 2 dessertspoonfuls of sugar and a little flavoring. After three minutes remove the saucepan from the fire and add to the contents the white of one egg which has been beaten to a froth. Now turn the whole into a shape previously cooled in cold water, allow the contents to set, and place the shape either in a cool place or in an ice-chest. By the end of a week the diet may include fish, eggs, oysters, squab, chicken, sweetbreads, custards, puddings, and the like. In uncomplicated cases ordinary diet may be resumed by the tenth or

*"The Preparation and After-treatment of Section Cases," London, 1905.

twelfth day. Vegetables should be given sparingly, or better not at all, before this time. This statement, unless in exceptional cases, applies also to fruits, although the juice of oranges and lemons may be taken much earlier.

Diet After Operations Upon the Stomach.—Competent surgeons vary greatly regarding the time at which to begin feeding after operation upon the stomach. Some allow milk by the mouth on the following day, others wait four to eight days, nourishment in the meanwhile being supplied by rectal feeding. As a routine it is better to supply food in the shape of enemas, if they be tolerated, for at least two days after stomach operations of any magnitude. Feeding by the mouth may then be begun as previously indicated for section cases in general. More care and a longer time are required, however, in increasing the quantity and in passing to the more substantial materials. The heavier solids should not be allowed until the beginning of the fourth week. When a gastric fistula is made, fluids may be given very soon after operation. Several days should be taken in returning to semi-solids, and two or three weeks to solids, if they are masticated by the patient before introduction.

Diet After Operation Upon the Intestine.—As examples of the general principles to be followed in these cases may be cited the directions of Deaver and of Kelly in their recent works on appendicitis. The former says: "No nourishment should be given by the mouth until the lapse of at least twenty-four hours after the operation. If at the expiration of this time the stomach has for some hours showed no evidence of irritability, albumin-water, one of the commercial preparations of beef, or a meat broth prepared by the nurse, or milk, peptonized by the cold process and the peptonization not carried so far as to render the milk bitter, in doses of a teaspoonful (or less) may be given if the stomach remains tolerant. Milk with lime-water may be used in place of the peptonized milk, and may be cautiously given every hour or two. A dram or so of whisky may also be given if required. If the stomach continues retentive, larger quantities of milk may soon be given—1 to 2 ounces every two hours—and the quantity increased or decreased according to circumstances, and the intervals lengthened as convalescence progresses. In addition to milk, chicken broth, bouillon, liquid beef peptonoids, beef peptones, dry champagne, etc., may be administered. If vomiting should return, absolute abstinence from food and liquids, for a time at least, will again become necessary." Kelly states

that "all nourishment should be suspended after the operation until the stomach is settled. The first food given should be egg-albumen, prepared by beating the whites of 4 eggs to a froth and allowing it to stand in a cool place for an hour or more, when the liquid (about 50 c.c.) can be drained off, leaving the frothy part behind. It is best to give a teaspoonful at a time mixed in 2 or 3 tablespoonfuls of cold water with a little sugar and 5 or 10 drops of lemon-juice. It may also be given in ginger ale, in orange-juice, or in sherry wine. About the third or fourth day soft food may be given, and after the first week a stronger diet may be gradually resumed. As a rule, attendants are overanxious to feed patients, who can often stand absolute starvation for four or five days very well." In cases of intestinal resection, feeding must be almost wholly by enemas for one week. During that time the desire of the patient for something by the mouth may be partially satisfied by giving 1 or 2 ounces of liquid food at four- or six-hour intervals. At the end of the week semifluid and later soft foods may be given by the mouth. Particular care should be taken to avoid materials that leave a large residue in the intestine.

Diet after operations about the gallbladder, pancreas, or kidney is in general that prescribed for laparotomy cases, but, in addition, certain precautions applicable to each may profitably be observed. When bile is draining externally or the pancreatic secretion is diminished, the exhibition of fats should be limited. The employment of specially digested foods is usually not necessary. When one or both kidneys have been operated upon, a diet approximating that found useful in cases of nephritis may be of service in relieving stress upon the weakened organ. Articles of diet commonly given in nonoperated affections of these organs will readily suggest themselves to the surgeon.

Diet After Operations About the Mouth.—Many patients who have undergone operation involving the mouth, especially young children who have had a cleft palate or harelip repaired, and older people who have had cancer of the lip, jaw, or tongue removed, tolerate food very soon after recovering from the anesthetic. Milk, preferably sterilized for a day or two, is the most desirable food, and usually may be begun with but little preliminary trial of blander fluids. Beef-juice is advantageous in some cases. The problem here is chiefly one of mechanics, how safely to get the food by the wound. To most patients it may be given by a spoon; being therewith placed far back on the tongue. In some instances a glass feeding-tube connected with a funnel holding the

food gives greater satisfaction; a pinchcock must be arranged to secure absolute control of the fluid. Feeding should for some days not be entrusted to the patient himself, even an adult, or to an untrained assistant; only an experienced nurse is competent properly to administer food in such cases. In special instances feeding will have to be accomplished through a nasal tube or even by the rectum. It must be remembered that sutured wounds about the mouth are usually under considerable tension and are inherently liable to separate; hence the necessity for extra precautions to prevent unnecessary movement of the parts.

Diet After Operations About the Head.—The chief indication here, especially if the brain has been disturbed, is to supply a diet that is light and easily digested and nonirritating in every way; the last point applies particularly to the circulatory system. Alcohol, except on the strongest positive indications, as in case of persons habitually using it, should not be administered. Liquid diet should be the rule for several days in severe cases, followed by a similar period of soft foods, the heavier solids being omitted until convalescence is well established. If the patient is partially or entirely unconscious, feeding by nasal or stomach-tube or even by nutrient enemas may be necessary.

The Use of Alcohol After Operations.—As among physicians in treating medical cases, widely divergent opinions are held by surgeons regarding the employment of alcohol after operation. Not a few give it in some form, as wine, whisky, or even brandy, practically as a routine measure. Disregarding entirely the temperance aspect of the question, I do not believe this general use is demanded or even advisable. Well-nourished persons previously unaccustomed to alcohol do not require it after uncomplicated operations. The rule should be not to give alcohol; to this exceptions may be made as indicated. Patients in profound shock, those exhausted by long illness or even by acute, rapidly wasting diseases, who can take or at least absorb but little food after operation, may well be given the supporting effect of alcohol as a temporary expedient until food can be assimilated; in such cases the alcohol should be discontinued at the earliest possible moment. In cases of profuse suppuration, and especially in septicemia, alcohol is most valuable. To persons accustomed to its use, especially in large quantities, it must be supplied after operation, the amount to be regulated by the demand based upon the previous consumption of the drug.

Feeding by Nutrient Enemas.—This should be accomplished by means of a rectal tube or large catheter gently inserted into the bowel

as high as possible—at least 8 to 12 inches. If practicable, the patient should lie on his side, with the buttocks slightly elevated. The food is introduced through a funnel or fountain syringe by gravity, never by means of a piston syringe. The temperature of the food should be from 92° to 94°. The amount should not exceed 8 ounces, and in many instances 4 or 6 will be better retained. Peptonized milk, milk and beaten eggs, milk-peptone, starch or sugar and milk, or other similar combinations may be employed. Many surgeons add a fourth or half ounce of wine or a small quantity of whisky. In cases when, soon after operation, stimulation rather than nourishment is desired, enemas of salt solution and hot black coffee are particularly efficacious. If the rectum is irritable, a preparation of opium given with, or just preceding, the enema will aid in its retention. Enemas should be given four, five, or six hours apart. Every twenty-four hours, or even oftener in some instances, the bowel should be thoroughly cleansed by copious high injections of saline solution; in rare cases, this may be advisable before each nutrient enema.

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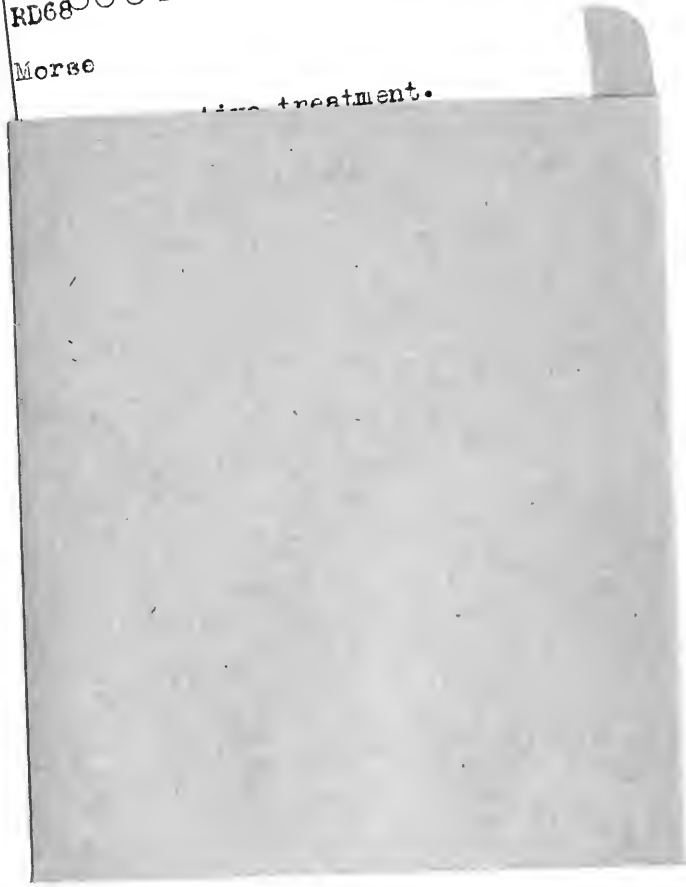
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